TAIT'S NEW SEAMANSHIP

TAIT'S NEW SEAMANSHIP AND NAUTICAL KNOWLEDGE

TAIT'S NEW SEAMANSHIP

And Nautical Knowledge

Steam and Sail

BY

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GLASGOW

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PREFACE TO THE THIRTEENTH EDITION.

THIS Edition has been revised and re-arranged to bring it more into touch with the present-day examinations. As some candidates are still going in for the "Sailing Ship endorsement" it has been thought proper to include the chapter relating to that subject. The important need of a better explanation on navigational instruments has been minutely attended to. Ship manoeuvring, anchoring and cargo work have been thoroughly overhauled. Many more illustrations have been included, lending more interest to the work and saving much time in understanding the text. Any suggestions as to the improvement of the work will be gladly received by the Publishers.

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BOARD OF TRADE REGULATIONS

The following extracts from the "Board of Trade Regulations relating to the Examination of Masters and Mates in the Merchant Navy" are those with which this work is concerned. The book may be purchased at any nautical booksellers.

SECOND MATE (FOREIGN-GOING).

40. **Paper 5.** (Written.)

Cargo Work and Elementary Ship Construction. ((3 hours.)

(*a*) The stowage and dunnaging of different varieties of cargoes, including bulk cargoes. Elementary ideas on the making and use of cargo plans.

The preparation for stowage, breaking out and discharge of cargo.

Rigging a ship for loading and discharging cargo, and the use of derricks and winches. Strength of cargo gear.

The calculation of capacities of bunkers, holds, tanks and boats.

Calculation of capacities taken up by part cargoes and of space remaining. Conversion of weight measurement of cargo into space measurement and *vice versa*.

(*b*) The names of the principal parts of a ship.

General ideas on ship construction and hull maintenance.

The candidate will be expected to show his practical acquaintance with certain portions of his own ship, *e.g.* longitudinal and transverse framing. Bulkheads. Hatches. Rudders and steering gear. Shell plating. Stern frame. Propellers and propeller shafts, stern tube, propeller brackets.

The stiffening and strengthening to resist panting, pounding and propeller vibrations.

Double bottom tanks, bilges, bilge pumps, sounding pipes. Ventilation systems of holds and tanks.

(*c*) Displacement. Deadweight.

Use of tons per inch immersion scale. Calculation of weight of cargo, etc., from draughts.

Effect of varying density of water.

Buoyancy. Centre of gravity and centre of buoyancy. The laws of floating bodies.

Effect of filling and emptying ballast tanks on centre of gravity of ship as a whole.

41. **Paper 6.** (Written.)

English. (1½ hours.)

The paper will be designed to test the candidate's ability to write clear and grammatical English with due attention to spelling and penmanship. It will be in no sense a test of technical knowledge.

42. **Oral and Practical Portions.**

1. (*a*) Rigging of ships. Strength of ropes, wire and hemp. Rigging purchases of various kinds and knowledge of power gained by purchases. Knotting and splicing hemp and steel ropes with strict reference to current practice. Seizings, racking chain stoppers, etc.

(*b*) Sending topmasts up and down.

(*c*) Bending, setting and taking in fore and aft sails. Management of boats under oars and sail and in heavy weather. Beaching or landing. Coming alongside.

(*d*) Helm orders. Conning the ship.

2. (*a*) Marking and use of ordinary lead line.

(*b*) Use and upkeep of mechanical logs and sounding machines.

(*c*) Use and upkeep of engine room and other telegraphs.

(*d*) Rocket and line throwing apparatus.

3. (*a*) Anchors and cables. Use, upkeep and survey.

(*b*) Knowledge of use and maintenance of deck appliances and steering gear.

(*c*) Fire extinguishing apparatus—steam, chemical and other appliances.

4. (*a*) Preparations and precautions for getting under way. Duties prior to proceeding to sea, making harbour or coming alongside, especially at after end of ship.

(*b*) Keeping an anchor watch. Dragging anchor.

(*c*) Duties of officer of the watch. Use of compass to ascertain risk of collision.

5. (*a*) A full knowledge of the content and application of the regulations for preventing collision at sea. (Candidates will not be placed in the position of handling a sailing ship, but will be expected to recognise a sailing ship's lights and to have a knowledge of her possible manoeuvres according to the direction of the wind.)

(*b*) Distress and pilot signals; penalties for misuse.

(*c*) British uniform system of buoyage.

(*d*) An intelligent use of "Notices to Mariners." (Candidates will not be required to commit these to memory.)

6.—*Signals.*

To send and receive signals in:—

(*a*) British Semaphore up to eight words per minute.

(*b*) Morse Code by flash lamp up to six words per minute.

(*c*) International Code of Signals.

7.—*Practical.*

(*a*) To read and understand a barometer, thermometer, hydrometer and hygrometer. (The instruments supplied by the Meteorological Office will be taken as standard.)

(*b*) To use an azimuth mirror, pelorus (bearing plate) or other instrument for taking bearings; to place these bearings on a chart, having corrected for given compass error.

(*c*) To use a sextant for taking vertical and horizontal angles; to read a sextant both on and off the arc.

(*d*) To correct a sextant into which has been introduced some or all of perpendicularity, side and index errors.

(*e*) To find the index error of a given sextant.

(*f*) To check chronometers by signal made by buzzer or other method; to compare two chronometers.

8. The Examiner may ask the candidate questions arising out of the written work, if he deems it necessary on account of weakness shown by the candidate. (This applies particularly to Paper 5.)

FIRST MATE (FOREIGN-GOING).

48. **Paper 4.** (Written.)

Ship Construction and Stability. (3 hours.)

(*a*) A general knowledge of the principal structural members of a ship. Midship sections of different types of ships, giving the parts their proper names. Scaling dimensions on a midship section to make intelligible reports.

Ability to set out in a clear manner a report on damage sustained by corrosion or by accident.

Construction and stiffening of watertight bulkheads.

Collision bulkhead.

Stern frame and stem and how secured.

Stresses and strains in ships through effect of seas or loading and ballasting.

A knowledge of those portions of a ship specially strengthened to withstand such stresses, or where excessive damage by corrosion is liable to occur.

Rivets and riveting. Testing a line of rivets. Testing watertight work.

Rudders and steering gear. Inspection and maintenance.

Hatches and hatch gear. Hawsepipes and cable lockers.

(*b*) Buoyancy and reserve buoyancy. The righting couple when a ship is inclined. Metacentre and metacentric height. Transverse and longitudinal metacentres. Stiff and tender ships—how to obtain stiffness. Stability at large angles of inclination and what this depends on.

Preparation of data for ascertaining metacentric heights of a ship in any particular condition.

Determination of centre of gravity of a ship in any condition, the centre of gravity in light condition being given. Use of stability curves and data supplied to a ship. Alteration of stability during a voyage. Effect of shifting cargo. Change of trim.

49. **Paper 5.** (Written.)

Ship Maintenance, Routine and Cargo Work. (3 hours.)

(*a*) Keeping a ship's log. (Mate's log.)

(*b*) Ship maintenance and organisation. Indents and stores. Repair lists. Properties and uses of paints. Painting, chipping, scraping. Cement work. Treatment of wood work. Inspection and maintenance of bulkheads, double bottoms, deep tanks, rudders. Bottom painting. Drainage of holds and double bottom tanks. Inspection and maintenance of anchors and cables. Maintenance of holds with reference to cargo carrying. Spar ceilings, etc. Inspection and maintenance of pumps, strums, roseboxes and bilges.

(*c*) Simple calculation of stresses in spans, derricks, topping lifts, etc. Strength of ropes, chains, slings, two slings at an angle, etc. Purchases and power gained by purchases.

(*d*) *Cargo work.*—(The candidate should, where possible, illustrate his answers from his own experience.)

Stowage of cargo. General—stowage of bag cargoes, bales, casks, etc.

Bulk stowage. Partition and shifting boards. Ceilings and dunnage. Deck stowage. Possible damage and its avoidance.

Good and bad stowage. Special cargoes—explosives, grain, timber, oil in bulk, steel rails, etc.

Given a cargo list, to stow a hold or holds, making a rough cargo plan, with a view to stability of tender and stiff ships, damage and contamination, easy handling and possible optional ports of discharge.

Methods of ventilation of cargoes. Drainage of holds.

Closing of hatches. Cargo working gear—derricks and winches. Organisation of cargo work.

50. **Paper 6.** (Written.)

Meteorology. (2 hours.)

(*a*) The principles of the barometer. How to read it and reduce the readings to standard datum.

(*b*) How to observe the force and direction of the wind with no other instrument than the compass and use of the Beaufort scale.

(*c*) How to observe and log the state of sea and swell, weather and visibility by the International scales for the use of seamen.

(*d*) The principles and use of the thermometer, dry bulb, wet bulb and sea surface.

(*e*) Use of hydrometer.

(*f*) General knowledge of the wind and current systems of the oceans. How to deduce the set and drift of currents.

(*g*) The Laws of Storms. Buys' Ballot's Law. Rules for handling ships in tropical revolving storms. The seasons and localities of tropical revolving storms and their precursory signs.

(*h*) The Visual Storm Warning signals.

(*i*) The seven fundamental types of weather.

(*j*) The elementary principles of synoptic charts, including a knowledge of how the atmospheric pressure distribution and gradient is obtained. Principal cloud types.

(*k*) To draft a wireless weather report and how to decode a weather report made in the International Weather Code, the tables being provided.

51. **Oral Portion.**

1. (*a*) Shifting large spars and rigging sheers.

(*b*) The handling of heavy weights with special reference to strength of gear used.

(*c*) Use and maintenance of all deck and above deck appliances and fittings—winches, capstans, windlasses, emergency steering gear, and fittings used between anchor and cable locker. Hoisting in boats.

(*d*) Bending, setting and taking in fore and aft sails. Management and equipment of ships' lifeboats and number of persons who may be carried in each class of boat.

2. Anchors—different kinds; advantages and disadvantages of each. How to rig a sea anchor and what means to employ to keep a vessel, disabled or unmanageable, out of the trough of the sea and lessen her lee drift. Cables and their care. Preparations for anchoring. Operation of anchoring with single anchor and use of second anchor. Clearing a foul anchor. Mooring. Clearing a foul hawse. Anchoring in a tideway and in a confined space. Dragging anchor. Anchor watch. Slipping a cable. To carry out an anchor with boats. Getting under way.

3. (*a*) Effect of propellers on the steering of a ship. Stopping, going astern and manoeuvring. Turning circles. Effects of current, wind, sea, shallows, draught.

(*b*) Coming alongside a wharf, etc. Turning a steamship short round, manoeuvring in rivers and harbours. Emergency manoeuvres. Man overboard.

(*c*) Management of steamships in stormy weather.

(*d*) To get a cast of the deep sea lead.

4. (*a*) Testing lifebuoys and life-jackets; other lifesaving gear.

(*b*) Accidents, *e.g.*, collision, running aground, accidents to hatches, leaks, fires and their treatment. Running repairs. Handling a disabled ship.

(*c*) A practical knowledge of the screening of ships' navigation lights.

(*d*) Preparation for dry-docking. Use of shores, bilge blocks and bilge shores.

5. **Regulations for Prevention of Collision at Sea**—as par. 42, Section 5 (Oral) Second Mate.

6. **Signals.**—As par. 42, Section 6 (Oral) Second Mate.

7. The Examiner may ask the candidate questions arising out of the written work, if he deems it necessary on account of weakness shown by the candidate.

MASTER (FOREIGN-GOING).

54. **Paper 2.** (Written.)

Meteorology. (2 hours.)

Ocean pilotage, *i.e.*, general knowledge of winds and currents, and the selection of routes according to season. Icebergs, ice signals, and ice navigation.

To be able to plot observations of ships and coast stations received by wireless, and to construct a simple weather chart. To understand the use of the observation of the change of the barometer by single and collective observations; and to make deductions as to probable changes of weather along the proposed track of his ship.

A general knowledge of the system of wireless weather signals (*when* one International system is brought about).

55. **Paper 3.** (Written.)

Ship Construction and Stability. (3 hours.)

(*a*) The direction of simple ship repairs. Drawing up of simple specifications.

(*b*) A fuller knowledge of ship construction than in previous examinations. General structure—transverse and longitudinal girders; keels; stern frame, stem and rudder post; centre keelson; bilge and side keelsons; side stringers; tank margin, intercostals; transverse framing. shell plating; rudder propeller brackets, masts and derricks.

Classification of ships. Tonnage—measurement and registration. Freeboard.

Treatment of accidents and damage—collision, springing leaks.

Possible strains incurred by action of waves, improper loading or ballasting, etc.

Working of ship, division of loads.

(*c*) Stability diagrams and use of stability curves and information. Effect of beam and freeboard on stability. Practical operations to ensure ship stability at sea. Ship with a list. Management of ballast tanks. Effect of free liquid surfaces and risks of flooding hold spaces, filling and emptying tanks at sea. Suspended weights and shifting cargoes. Deck cargoes. Homogeneous cargoes. Ballasting. Effect of admission of water into interior of a ship. Flooded compartments. Stability and trim of a stranded ship. Trim—moment to change trim.

57. **Paper 5.** (Written.)

Ship's Business. (2 hours.)

(The legal information required will not go beyond the outline of Mercantile Law which the shipmaster must know for practical purposes.)

(*a*) The official log and reports on exceptional entries.

(*b*) A shipmaster's knowledge of the law relating to:—

(1) Engagement, discharge and management of a ship's crew. Ship's articles of agreement. Discipline and treatment of offences.

Wages and other remuneration. Food and accommodation. Entering and clearing the ship. National Insurance of crew.

(2) Tonnage, life-saving appliances, salvage and assistance and, in general, the safety of ship, crew and passengers.

(3) Loadline marks and entries and reports to be made respecting them. Surveys required by law.

(4) Hygiene of ships, living spaces, holds, etc. Water. Fresh and preserved food. Infectious diseases. The law relating to them and the procedure on board in such case. Quarantine procedure. Recognition and simple treatment of common illness, *e.g.*, fevers, etc. (See the *Ship Captain's Medical Guide.*)

(5) The carriage of emigrants.

(*c*) A simple knowledge of the law relating to cargo, including a knowledge of shipowners' liabilities in carriage of cargo.

(*d*) A general knowledge of shipping business and documents—charter parties, bills of lading, etc. A knowledge of average—general and particular. Flotsam and jetsam.

59. **Paper 7.** (Written.)

Engineering Knowledge (including carriage of refrigerated cargoes). (3 hours.)

(The requirements will not go beyond the knowledge that could be obtained by a deck officer who takes an intelligent interest in the machinery of the ship and supplements by a little reading what he has learnt in this way.)

(*a*) The meaning of general engineering terms, *e.g.*, horse power, slip and pitch of propeller, link, latent heat of steam, superheated steam, etc.

A general knowledge of a marine boiler and furnaces, and the procedure for raising steam. The general action of a reciprocating steam engine. Principle of the condenser. Distribution of steam from boiler to engines—valves and pipelines. Admission to engine—slide valves, eccentrics, expansion link. Starting gear. Simple description (without detail) of various parts of engines and boilers—*e.g.* connecting rod, crank, piston and rings, packing of piston rods, relief valves and cylinder drains, line shafting, couplings, tail shaft, stern tube and packing. Auxiliaries and their uses—circulating pump, air pump, feed pump, bilge pump. Action of propeller, Thrust block. Attachment of propeller to shaft.

Oil fired furnaces and use of oil fuel. A simple knowledge of turbine machinery and of Diesel engines. Warming up and turning engines. Stopping and going astern—how done. A knowledge of what is required in the engine room on the receipt of manoeuvring orders from the bridge. Fuel consumption and economical speeds. Power and speed curves. Effect of alterations of speed on fuel consumption and estimation of adequacy of fuel to complete a given voyage.

(*b*) An elementary knowledge of refrigeration on board ship. Types of refrigeration on board ships. Types of refrigeration employed in special cases. Stowage and general handling of refrigerated cargoes.

60. **Oral Portion.**

1. (*a*) Exceptional circumstances—loss of rudder; shifting a damaged rudder. Construction of jury rudders. Making and launching of rafts. Collision. Leaks. Damage of all kinds. Running repairs and precautions in case of accidents. Grounding—methods of refloating. Beaching a vessel. Steps to be taken when disabled and in distress.

(*b*) Preservation of crew and passengers in the event of wreck. Abandoning a wrecked ship. Rockets and rocket apparatus. Communications with the shore.

(*c*) Assisting a vessel in distress. Rescuing crew of a disabled ship.

(*d*) Towing and being towed.

(*e*) Bad weather manoeuvres. Precautions at anchor and at sea. Use of oil.

Anchoring and working anchors and cables in all circumstances. Approaching rivers and harbours and manoeuvring in them.

(*f*) Drydocking. General procedure and precautions to be observed. Distribution of weight. Drydocking with full cargo for inspection of propellers or shafting. Bilge beds. Leaving the vessel water borne. Putting into port with damage to ship and/or cargo, both from business and technical points of view. Safeguarding of cargo.

(*g*) Prevention of fire at sea. Spontaneous combustion of fuel cargoes. Full knowledge of the use of fire extinguishing appliance and precautions to be observed in cases of danger to life. Special reference to extinguishing of oil fuel fires.

(*h*) Methods of fumigating holds and living spaces and safeguards in applying them.

(*i*) General organisation of ship's work and handling of crew.

2. **Regulations for Prevention of Collisions at Sea, etc.** As par. 42, Section 5 (Oral) Second Mate.

3.—*Signals.*

As par. 42, Section 6 (Oral) Second Mate.

4. The examiner may ask the candidate questions arising out of the written work, if he deems it necessary on account of weakness shown by the candidate.

73. **Sailing Ship Endorsements.**—A candidate for a sailing ship endorsement of any grade who has not previously held an endorsement of a lower grade or an Ordinary certificate of a lower grade issued prior to January, 1931, must prove that he has served 12 months in the foreign trade or 18 months in the home trade, in a square-rigged sailing vessel. Service in vessels with auxiliary steam or motor power, which use their propelling machinery only in calms or during light winds, is considered as service performed in sailing vessels.

Subject to the above qualification, a candidate may be examined for a sailing ship endorsement of any grade at the same time as he is examined for a certificate of competency of the same or of a higher grade. If a candidate desires to be examined for a sailing ship endorsement only, he must possess a certificate of competency of at least the same grade as the endorsement which he requires.

74. **Second Mate, Sailing Ship Endorsement.**—The candidate must understand and give satisfactory answers on the following subjects:—

(*a*) The standing and running rigging of ships.

(*b*) Bending, unbending, setting, reefing, taking in, and furling sail.

(*c*) Sending masts and yards up and down, etc.

(*d*) Management of a ship when under canvas.

(*e*) The Rule of the Road as regards sailing vessels, their regulation lights and fog and sound signals.

(*f*) Any questions appertaining to the duties of a Second Mate of a sailing ship that the Examiner may think necessary to ask.

75. **First Mate, Sailing Ship Endorsement.**—In addition to the qualifications required for a Second Mate's sailing ship endorsement, the candidate will be required to show a knowledge of the following subjects:

(*a*) Shifting large spars, rigging sheers, taking lower masts in and out.

(*b*) How to moor and unmoor ship; to keep a clear anchor; and to carry out an anchor.

(*c*) How to manage a ship in stormy weather, and to cast a ship on a lee shore.

(*d*) How to secure the masts in the event of accident to the bowsprit.

(*e*) How to rig purchases for getting heavy weights, anchors, machinery, etc., in or out.

(*f*) How to get a cast of the deep sea lead in heavy weather.

(*g*) Accidents, and how to deal with them.

(*h*) Any other questions appertaining to the duties of an Only or First Mate of a sailing ship which the Examiner may think necessary to ask.

76. **Master, Sailing Ship Endorsement.**—In addition to the qualifications required for the sailing ship endorsement for Second and First Mate, the candidate will be required to show a knowledge of the following subjects:—

(*a*) Management of ship in heavy weather.

(*b*) Rescuing the crew of a disabled vessel.

(*c*) Steps to be taken when a ship is on her beam ends, or in any danger or difficulty, or disabled or unmanageable and on a lee shore.

(*d*) Heaving a keel out.

(*e*) Any other question appertaining to the management of a sailing ship which the Examiner may think it necessary to ask.

MATE (HOME TRADE.)

80. **Oral.**

1. The content and application of the regulations for preventing collision at sea.

Distress and pilot signals; penalties for misuse.

The use of the rocket apparatus.

An intelligent use of "Notices to Mariners" (Candidates will not be required to commit these to memory).

2. Marking of ordinary lead line.
The use and upkeep of mechanical sounding machines and logs.
Construction and use of engine-room telegraphs.
Anchor work; coming alongside; mooring and unmooring.
Management of a ship's boat.
3. Undertaking of bulkhead sluices, bilges, bilge pumps, water ballast tanks, sounding pipes and the ventilation of holds.
Fire extinguishing appliances.
4. An elementary knowledge of cargo work, as given in the syllabus for First Mate (Paper 5. Section (*d*)).
5. To read and understand a barometer and a thermometer.
To use a sextant for taking vertical and horizontal angles and to find the index error.
Signalling.—British Semaphore up to 8 words a minute.
Morse flashing up to 6 words a minute.
International Code of Signals.

MASTER (HOME TRADE.)

85. **Oral.**

1. International Regulations for Prevention of Collision at Sea and everything contained in Section 1 (Mate Home Trade).
2. Handling a ship in bad weather and when it is disabled.
Preservation of crew and passengers in event of wreck.
A fuller knowledge of mechanical sounding machines and logs.
Effect of screws on steering of a ship.
3. Understanding of effect produced by filling and emptying ballast tanks and loading and unloading cargo on the centre of gravity of the ship as a whole; the danger of free liquid surfaces in tanks and holds.
4. A shipmaster's knowledge of the law relating to loadline marks and entries and reports to be made respecting them.
5. To read and understand a barometer, thermometer and hydrometer.
Signalling.—As for Mate (Home Trade).

HINTS TO CANDIDATES.

Although you are sitting for a steamship certificate, you are expected to know the various rigs of ships and the sails they carry. Pages 108 to 114.

Shipbuilding.—The questions on ship construction are elementary for Second Mates and Mates. (*See beginning of book.*)

Boats.—Special attention must be given to the launching and management of boats under oars, sails, and in heavy weather; also to the sails for steamers as drawn in this book.

Steamship.—You should be familiar with the working of the lead line, log line, and use of the rocket apparatus, also the care and usage of mechanical logs and sounding machines, how to send up and down topmasts, how to moor and unmoor ships, stowage of cargo, etc.

Notice to Mariners.—All Grades should read up the latest Notice to Mariners.

Signals.—Special attention must be given to signals. Study the various hoists as shown in Section II. You are required to attain a speed of 6 words a minute in Morse flashing, and 8 words a minute in Semaphore. The average word is 5 letters.

Rule of the Road.—Learn all the articles, and study the questions and answers for both steam and sailing ships as shown in Section III.

Senior Grades.—Special attention to heavy weights, coal and grain cargoes, seamanship, etc.

SUPPLEMENT

WAR-TIME SAFETY MEASURES.

EXTRACTS from Ministry of Shipping Notice No. M.191 including subsequent alterations and additions.

LIFEBOATS.

Carrying of Boats Outboard.—Lifeboats attached to davits, so far as the type and position of the davits will permit, must be carried in the outboard position when the ship is in the danger area, so that they can be quickly lowered in an emergency, unless the master of the ship, having due regard to the safety of the boats in the circumstances prevailing, considers it inadvisable to carry them in that position.

Boats to be Class I.—All lifeboats must be of Class I. Where Class 3 boats are carried as part of the Statutory Life-Saving Equipment, they are to be converted to Class 1.

Means of Clinging to Upturned Lifeboats.—All lifeboats carried by sea-going ships should be fitted with bilge keels or keel rails so constructed as to enable persons to cling to them should the boats be upturned.

Equipment Required.—The war-time equipment of lifeboats must include the following:—

(*a*) The full banked complement of oars and two spare oars and a steering oar;

(*b*) Two plugs for each plug hole attached with lanyards or chains, and one set and a half of thole pins or crutches attached to the boat by lanyards. Plugs are not required where proper automatic valves are fitted;

(*c*) A sea anchor, a baler, a galvanised iron bucket, a rudder and a tiller or yoke and yoke lines, two painters of sufficient length and a boat hook; the rudder, the baler and the bucket are to be attached to the boat by sufficiently long lanyards and to be kept ready for use; one of the painters is to be secured in the forward part of the boat with a strop and toggle so that it can be released from the boat, and the other is to be firmly secured to the stem of the boat and be ready for use;

(*d*) Vessels capable of holding a minimum supply of water of 112 ozs. (nearly 3 quarts) per person the boat is certified to carry and provided with a dipper and lanyard, at least three small drinking vessels of enamelled or rust-proofed metal are to be provided—one marked as a measure, in ½ oz. sections from 1 oz. to 2 ozs. for the rationing of water.

(*e*) Two hatchets, one to be kept at each end of the boat and to be attached to the boat by a lanyard;

(*f*) A line securely becketed round the outside of the boat;

(*g*) An efficient lantern trimmed, with oil in its receiver sufficient to burn for eight hours, or with some other lantern or light of approved type, and with a box of suitable matches in a water-tight case;

(*h*) A mast or masts and at least one good sail and proper gear for each;

(*i*) An efficient compass;

(*j*) The "minimum" food rations are to consist of biscuits of new type, chocolate, milk tablets and pemmican at the rate of 14 ozs. of each food per person the boat is certified to carry. All the foods are to be in such a form as to enable them to be readily and fairly rationed;

In each case of pemmican, standard size spoons will be provided, and the dried milk and chocolate will be in the form of small wrapped tablets of standard sizes.

(*k*) A supply of one gallon of vegetable or animal oil and an appliance of approved pattern for distributing the oil easily on the water, arranged for attachment to the sea anchor;

(*l*) One dozen red flare lights in a water-tight case;

(*m*) An approved first-aid outfit in a water-tight case;

(*n*) Not less than six good quality woollen blankets in water-proof covering;

(*o*) A canvas hood or other suitable cover for providing shelter for the occupants of the boat;

(*p*) An electric torch suitable for Morse signalling;

(*q*) A suitable locker for the stowage of the small items of the equipment.

Safeguarding of Food.—The foods will be packed in sealed and rust-proofed metal containers of small size. Approximately 1 lb. and 2 lb. sizes (for rafts and lifeboats respectively) will be adopted for biscuits and chocolate. For dried milk and pemmican only one size will be used for rafts and lifeboats, the former containing about 1 lb. and the latter not exceeding ½ lb.

Means of Massage.—One gallon of fish, animal or vegetable oil is to be provided in each lifeboat and raft. Sperm oil is particularly useful. Containers are to be marked "Oil for Massage".

Security of Equipment.—With the exception of the boat hook which must be left free for fending off purposes, all items of lifeboat equipment not kept in the lifeboat locker should be lightly lashed within the lifeboat.

Shelter for Occupants.—Canvas hoods must afford a reasonable amount of shelter, covering about one-third the length of the boat, must be easy to rig when afloat and should be supplemented by a weather cloth which can be rigged abaft the hood and transferred from side to side, according to the direction of the wind.

Contents of First-Aid Kit.—The first-aid kit need not be elaborate or costly, but among the contents should be a pair of scissors (one blade sharp, the other blunt), a tourniquet, bandages, picric

lint burn dressings, boric lint dressings, cotton wool, adhesive plaster, safety pins, liquid Iodi Mitis and camel hair brush, factory eye drops with dropper, and aromatic spirits of ammonia (sal volatile). In addition a supply of splints and brief instructions on First Aid should be included. The kit must be enclosed in a water-tight metal container to keep it free from damage by sea water.

Means of Clearing Water from Boats.—In addition to the present bucket and bailer, a manual pump is now required in each lifeboat in a foreign going ship.

Life-saving Waistcoats, with Lights.—All members of crews engaged on sea-going ships passing through the danger area are required to be provided, in addition to the standard life-jacket, with a safety appliance which can be worn whilst on duty, in the form of an approved type of life-saving waistcoat or alternative approved appliance. The provision of an approved type of light suitable for use with the life-jacket or life-saving waistcoat is also now compulsory.

Protective Garment.—The life-saving kapok-filled waistcoat already provided for all members of crews of merchant ships, for constant wear on board ship in the danger area, has been found to be of particular value to occupants of lifeboats and rafts because of its warmth. A further garment is in course of development which is intended solely for wear in a lifeboat or raft as a means of personal protection against cold and water in conjunction with the kapok waistcoat.

Rafts or Similar Appliances.—All sea-going ships must be provided with emergency rafts or similar appliances sufficient for all persons on board.

Emergency rafts are to be effective and stable when floating either way up. In their construction particular attention should be given to the fastenings, which should be mainly by means of through bolts.

They should be stowed forward and aft as far remote from the lifeboats as practicable, so as to minimise the risk of damage to both rafts and lifeboats in the event of enemy attack.

They should be free to float clear in the event of the vessel sinking before they can be launched and, if lashed, of a type which can be readily freed.

Equipment for Rafts or Similar Appliances.—All rafts and buoyant apparatus must have attached to them a self-igniting buoyant light and a painter and the equipment must include the following:—

(*a*) A lifebuoy (with line);

(*b*) At least two paddles;

(*c*) A receptacle containing 6 gallons of fresh water and 5 lbs. of each of the same four foods as those required for lifeboats.

(*d*) One dozen red flare lights in a water-tight container.

All the equipment is to be effectively secured and readily accessible whichever way up the raft may float.

Light heaving lines would sometimes be useful on rafts.

Bungs of milk and water containers should be of non-corrodible metal.

Implements for removing them should be provided. Water containers should be fitted with dippers and lanyards.

Means of Attracting Attention of Aircraft and Passing Ships.—Each lifeboat should carry a yellow or bright orange bunting flag (4 ft. 6 in. by 8 ft.) attached to a light spar at one end, which can be triced up to the boat's mast.

To attract the attention of aircraft the flag should be held in a horizontal position.

The canvas hood or cover in each lifeboat should be coloured yellow or bright orange.

Lifeboat sails should be coloured red, or alternatively, a large square of material of this colour should be fastened to the sails; (paint should not be used for this purpose).

Rafts should be provided with a piece of stout material, about 6 ft. by 10 ft., coloured yellow or bright orange which could be spread horizontally to attract the attention of aircraft, and stout enough to be used as a means of affording weather protection.

Smoke Signals.—All lifeboats and rafts should be provided with at least six flares suitable for making smoke flares and carried in air-tight containers. These are for attracting attention of patrolling aircraft.

Jack Knives.—Each officer and supervising deck rating should be supplied with a jack knife; this knife is to be fitted with a tin opener.

These knives should always be carried by the persons to whom they are issued.

Safeguarding of Buoyancy.—In the event of lifeboats, emergency rafts and similar buoyant apparatus suffering damage from machine gun attack, or from shell, or bomb splinters, the buoyancy if provided in the form of metal air cases, may be seriously impaired or destroyed. Any of the following measures could be adopted:—

(*a*) The filling of metal air cases with kapok packed at about 3 lbs. per cubic foot.

(*b*) The use as internal buoyancy of an approved expanded rubber compound suitably protected.

(*c*) The fitting of external buoyancy (fixed or portable) in the form of mattresses filled with kapok packed at about 3 lbs. per cu. ft., expanded rubber or other approved material in addition to the metal air cases.

Repair Equipment.—To enable lifeboats, rafts and other similar buoyant apparatus, if damaged by machine-gun fire or shell or bomb splinters to be quickly made seaworthy, a supply of suitable materials and tools readily available should be carried. Among materials considered useful for making good such damage, are the following:—

(1) *For Wood Boats.*—Assorted sizes of softwood plugs, kept in a canvas bag, for dealing with clean bullet holes; patches of lead, together with a supply of copper tacks, for covering holes of irregular shape; white lead or paint, for making water-tight joints; plastic compound; short lengths of planking, of larch or other suitable material which will not split readily; screws and nails, and canvas.

(2) *For Steel Boats.*—Tapered screw plugs for dealing with clean bullet holes; metal washers and bolts of assorted sizes; rubber or canvas insertion; plastic compound; white lead or paint for making water-tight joints, and waterproof adhesive tape.

(3) *For Metal Air Cases.*—Some of the materials suggested above for steel boats would be useful.

Tools.—The tool kit might include brace and bits, screw driver, small saw, chisel, hammer, putty knife, and spanners according to circumstances.

Other items of equipment which would sometimes be useful are:—an outfit comprising a palm, needle and twine; a grapnel with line, and light heaving lines; also two grab lines going round the boat and attached to the bilge keels, with loops, for righting a boat when it is capsized.

Stowage.—The materials and tools should be stowed so as to be readily available in an emergency and a suitable supply might, with advantage, be carried in each boat.

Supplementary Water and Food Rations.—The first consideration is fresh water, and provision in excess of the "minimum" requirements should be made where reasonably possible. To provide variety in limited space, the addition of nuts (excluding hard shell varieties) and dried fruits is recommended in lifeboats; but they should not be stored for long periods.

Additional Lifebuoys with Lights or Lines.—The war time rules make compulsory in all sea-going ships in the danger area, the provision of a minimum number of eight lifebuoys in ships of 100 ft. and over in length, and four lifebuoys in ships of less than 100 ft. in length. At least half of these lifebuoys are to be fitted with self-igniting buoyant lights and two of the remaining lifebuoys with a line at least 15 fathoms in length. They should be

stowed in positions when they can be readily thrown overboard for the assistance of men struggling in the water.

The self-igniting buoyant lights fitted to lifebuoys on tankers, motor ships and oil-fuelled ships are to be of the electric battery type.

Side Ladders.—Two side ladders, additional to those required under the Statutory Rules, should be provided on all ships, and stowed on the weather deck, one near each end of the ship.

Rope Side Nets.—On many occasions the use of a rope net, such as a cargo net has been the means of saving life by enabling the crews of sinking ships to board lifeboats quickly after the boats were waterborne. They have also been found of value in assisting survivors found at sea to board rescue ships. The Ministry recommend that all sea going ships should be provided with a rope net which can be used, as occasion may demand on either side of the ship in addition to the rope ladders; these nets should be approximately 10 ft. wide, and fitted with ropes to enable them to be lowered or pulled up as required.

Protection of Crews of Tankers from Burning Oil.—Each member of the crew is to be supplied with a light fabric one-piece flame-proofed garment representing a combination of hood with mica eye-piece, a cape of ample proportions, and gauntlets. The garment is intended to furnish immediately available protection against flames, and particularly to protect the face and hands during the process of launching boats.

Manual Pumps.—A manual bilge pump adapted for spraying water is to be provided in each lifeboat.

Asbestos Blankets.—An asbestos blanket (size approximately 8′×6′) fitted with asbestos tie ropes, will be provided in each boat and will afford protection for the occupants until the water spray from the manual pump can be brought into operation. This blanket should be kept in the boat in a canvas cover made on board ship and be readily available for instant use.

Protection of Boat, Mast, Sails and Oars.—The hull of each boat should be painted externally with fire-proof paint.

The mast, oars, canvas hood, and sail cover should be fire-proofed.

Section I.

FOR ALL GRADES

Tait's New Seamanship.

SHIP CONSTRUCTION.

A ship may be looked upon as a large girder, subject to many strains, some caused by the way in which she is loaded, others by the seas she has to encounter. When a vessel is supported by a wave at each end, the midship portion being practically unsupported tends to droop. This is known as sagging. Again, when a vessel is on top of a wave amidships, the ends tend to droop. This is known as hogging. Heavy seas on the sides tend to make the structure go out of shape sideways and this is called racking.

The ship has to be so constructed to withstand these various stresses.

Longitudinal stresses are counteracted by the keel, keelsons, stringers, and the strakes of plating of which the garboard, bilge and sheer strakes are heavier than the others.

Transverse stresses are counteracted by the floors, frames, beams, beam knees, and tank side or bilge brackets. Naturally, transverse and longitudinal bulkheads bear a large share in giving added strength. Pillars, tank tops, stem and stern post all unite in strengthening the structure.

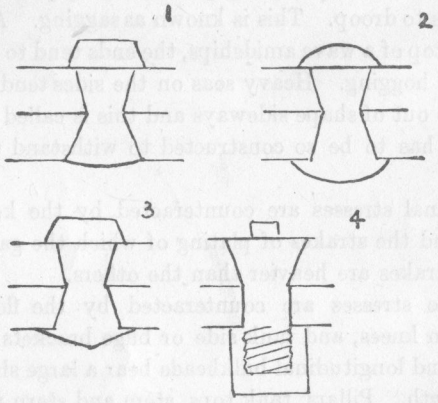
The most important part of the ship's structure is the shell plating, being the chief source of strength and making her watertight.

The side of the plate into which the punching tool enters is called the faying surface and two faying surfaces are always placed together when being riveted. This is because the hole from which the plug of steel emerges is always larger and burred

around the edge, but the rivet on being hammered up fills this completely.

Plates are also cut or sheared from the same side.

A stern tube is made of cast iron placed through the after peak from the tunnel, being held in position at the after end by a large nut, and forward to the after peak bulkhead by a flange bolted to the bulkhead. At the forward end is a gland stuffing box fitted with soft packing. At the after end strips of lignum vitae fixed into a brass liner forming the stern bush; this wood is prevented from working out by a guard ring bolted on to the stern tube nut. The lignum vitae is usually dove-tailed into the metal liner with the grain on end.



Rivets.

The collision bulkhead must be placed not less than one twentieth of the vessel's length abaft the stem, and in a sailing vessel, not less than half the greatest breadth.

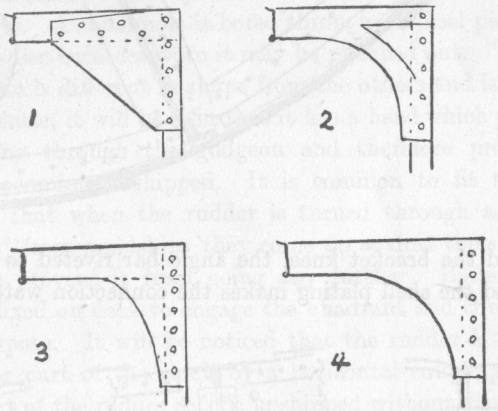
There are quite a number of kinds of rivets, probably the most common being the pan head, although above the water line it is not uncommon to see snap head rivets. There is also another rivet called the tap rivet, which as its name implies is more of

a bolt than a rivet, being screwed into position in places where it is not possible to fit a through rivet.

Also the finish up of a rivet varies quite a lot. There is the snap finish, flush finish and boiler point. Probably the boiler point is the strongest. Snap rivets snap finish are very strong but frequently allow water to get under them, thus more easily rusting and working loose.

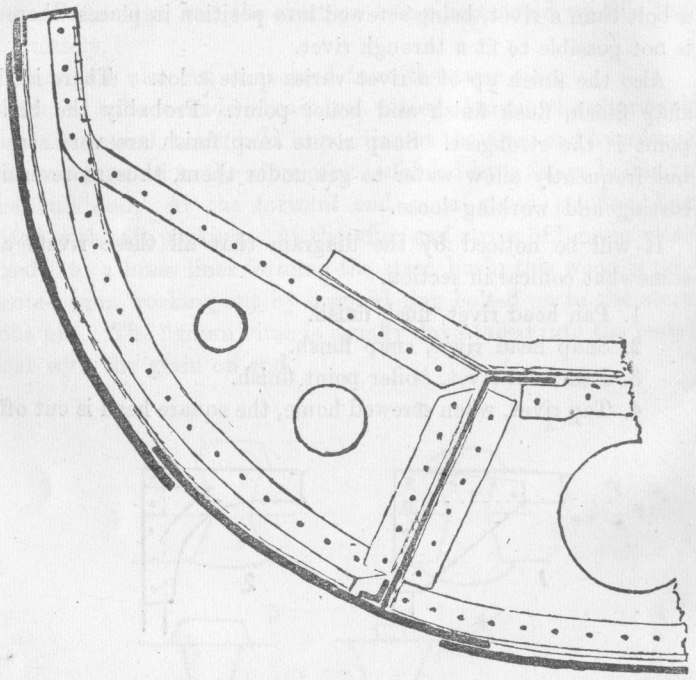
It will be noticed by the diagram that all these rivets are somewhat conical in section.

1. Pan head rivet, flush finish.
2. Snap head rivet, snap finish.
3. Pan head rivet, boiler point finish.
4. Tap rivet, when screwed home, the square head is cut off.

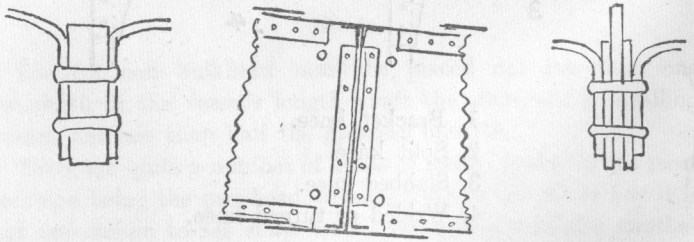


1. Bracket knee.
2. Split knee.
3. Slabbed knee.
4. Welded or turned knee.

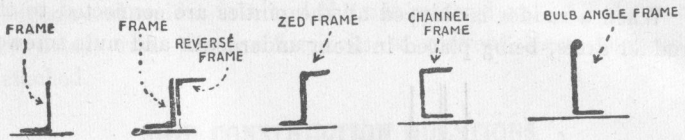
The diagram shows the connection of a margin plate to the



floor and the bracket knee, the angle bar riveted to the margin plate and the shell plating makes the connection watertight.



Bar Keel. Flat Plate Keel. Side Bar Keel.



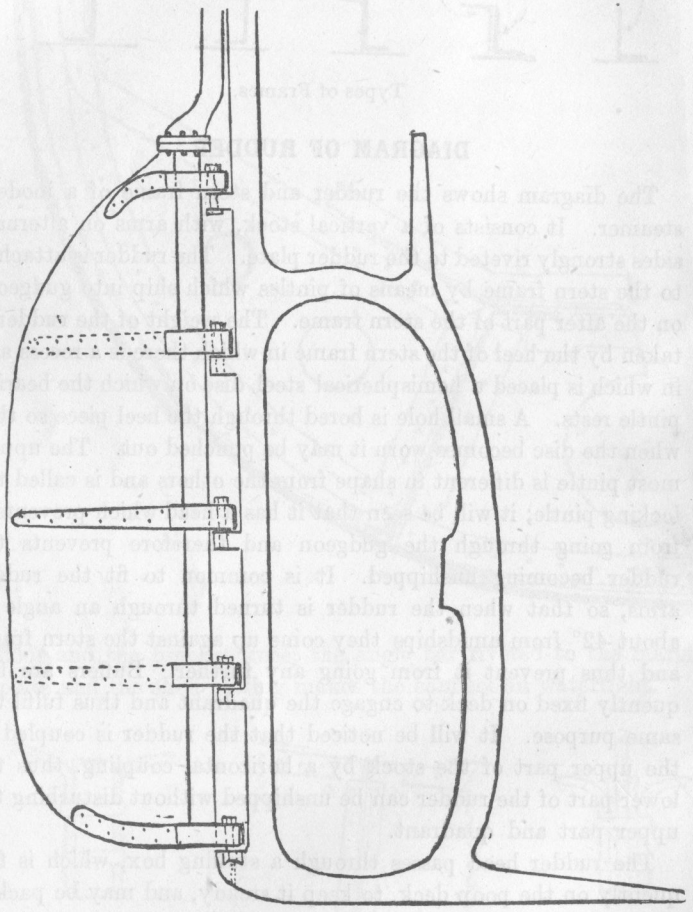
Types of Frames.

DIAGRAM OF RUDDER.

The diagram shows the rudder and stern frame of a modern steamer. It consists of a vertical stock, with arms on alternate sides strongly riveted to the rudder plate. The rudder is attached to the stern frame by means of pintles which ship into gudgeons on the after part of the stern frame. The weight of the rudder is taken by the heel of the stern frame in which there is a recess and in which is placed a hemispherical steel disc on which the bearing pintle rests. A small hole is bored through the heel piece so that when the disc becomes worn it may be punched out. The uppermost pintle is different in shape from the others and is called the locking pintle; it will be seen that it has a head which prevents it from going through the gudgeon and therefore prevents the rudder becoming unshipped. It is common to fit the rudder arms, so that when the rudder is turned through an angle of about 42° from amidships they come up against the stern frame and thus prevent it from going any further. Buffers are frequently fixed on deck to engage the quadrant and thus fulfil the same purpose. It will be noticed that the rudder is coupled to the upper part of the stock by a horizontal coupling. thus the lower part of the rudder can be unshipped without disturbing the upper part and quadrant.

The rudder head passes through a stuffing box, which is frequently on the poop deck, to keep it steady, and may be packed like an ordinary gland, but in some cases consisting of heavy steel blocks with lignum vitae liners. They are kept in close contact with the rudder head by long steel wedges.

When a rudder is shipped all the pintles are connected to the rudder arms, being placed in from underneath and nuts screwed



on to prevent them becoming disconnected. When the rudder is lowered into position the locking pintle is placed up through the

gudgeon and rudder arm and the nut screwed on. All the nuts are fitted with pins or forelocks to prevent them becoming detached.

SHIP CONSTRUCTION QUESTIONS

What is the hull?

The hull is the principal body of the ship without masts.

What is the keel?

The keel is the backbone of the vessel and runs fore and aft; the flat plate keel is in general use for steel vessels.

Side keelsons are the keelsons fitted inside on each side of the middle line keelson.

Bilge keels are fitted outside the vessel and extend about half the length of the ship to prevent heavy rolling.

What is shell plating?

It is the most important part of structure of a steel vessel and the main source of her strength; the thickness of shell plating is determined according to Lloyd's Rules.

What is a strake?

A strake is a line of shell plating extending the length of the vessel.

What is a stealer?

Stealer plates are the plates wherein one strake takes the place of two; *i.e.* at the extremities of the vessel where the girth decreases.

Where is the garboard strake situated?

At the bottom of the vessel on either side of the keel.

Where is the sheer strake situated?

It is the uppermost strake of shell plating adjacent to the upper deck beams.

What are frames?

Frames are the ribs of the vessels.

A frame angle bar extends from the keel to the gunwale. Frames, reverse frames and floor plates are connected by rivets, spaced about seven diameters apart.

What are floor plates?

Floors are vertical plates in the bottom of the ship extending from bilge to bilge, riveted to the frame on the lower part and to the reverse frame on the upper part. Usually they are joined to the middle line keelson by angle bars, but sometimes are continuous; usually there are holes cut in them to make them lighter, without any loss of strength.

Floor plates are made thicker in the engine and boiler room spaces of a steamer.

Where are the bilges situated?

At the bottom of the holds—out in the wings—a suction pipe runs to each hold bilge, and the end of the pipe enters a perforated box (rose-box) which prevents the pipe getting choked with dirt in the limbers.

How are frames usually numbered?

From aft forward.

How are strakes of shell plating marked?

Alphabetically, the garboard strake next the keel being known as *A* strake, and so upwards to the sheer strake.

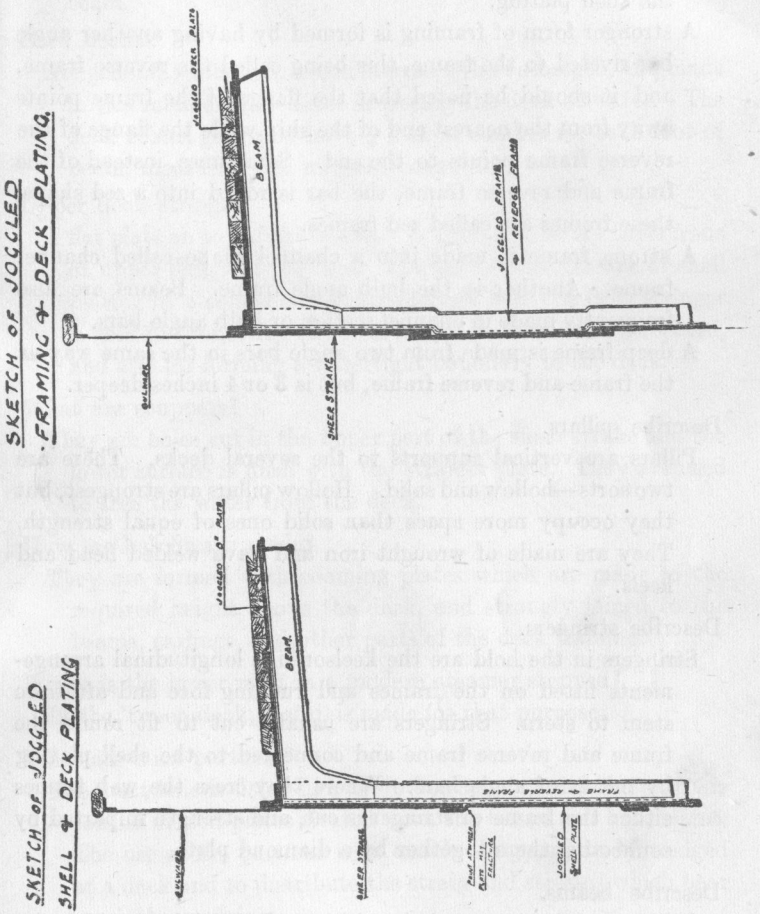
What is an inner and outer strake?

The strakes of shell plating are fitted alternately, inner and outer strakes. The inner ones are placed against the frames, but the outer strakes require to have liners between the plate and the frame.

If the frames are joggled (which is generally done) or if the outer strakes are joggled, then it is not necessary to fit liners between the frames and the plate.

What is a frame and reverse frame?

The frames extend from the keel to the gunwale, but where



ballast tanks are fitted they are cut to allow the margin plate to be continuous. The short flange of the frame is riveted to the shell plating.

A stronger form of framing is formed by having another angle bar riveted to the frame, this being called the reverse frame, and it should be noted that the flange of the frame points away from the nearest end of the ship while the flange of the reverse frame points to the end. Sometimes, instead of the frame and reverse frame, the bar is rolled into a zed shape; these frames are called zed frames.

A strong frame is made into a channel shape called channel frame. Another is the bulb angle frame. Beams are also frequently made in channel section or bulb angle bars.

A deep frame is made from two angle bars in the same way as the frame and reverse frame, but is 3 or 4 inches deeper.

Describe pillars.

Pillars are vertical supports to the several decks. There are two sorts—hollow and solid. Hollow pillars are strongest, but they occupy more space than solid ones of equal strength. They are made of wrought iron and have welded head and heels.

Describe stringers.

Stringers in the hold are the keelson-like longitudinal arrangements fitted on the frames and running fore and aft from stem to stern. Stringers are usually cut to fit round the frame and reverse frame and connected to the shell plating by means of angle bars. Where they cross the web frames either the frame or stringer is cut, and strength imparted by connecting them together by a diamond plate.

Describe beams.

Beams are transverse pieces of heavy iron (girders) which run across the ship and support the deck. The beams are connected to frames by means of knees of which there are several

forms, the most common being the bracket knee. The depth of the knees must be three times the depth of the beam.

Deck beams.

Are generally rounded, which increases their strength, and made in this manner they assist in freeing the deck of water. The deck beams generally have $\frac{1}{4}$ inch of camber for each foot of beam, measuring the midship beam.

Upper deck stringer.

A flat plate on top of the beams. It is riveted to the angle irons or upper flange of the beam, also to the sheer strake of shell plating by a continuous gunwale angle bar. A deck stringer is used in connecting the deck beams to the side of the vessel, and also for forming a watertight boundary to the deck.

What are scuppers?

They are holes cut in the upper part of the sheer strake and the lower surface is flush with the stringer plate. They are used to free the water from the deck.

How are hatchways made?

They are formed with coaming plates which are made to the required height above the deck, and strongly joined to the beams, carlings, and other parts of the deck framing.

Where is the lower mast in a modern steamer stepped?

In the 'tween deck; a step is made for that purpose.

What are mast partners?

The mast hole is fitted like any other opening and the partners consist of iron plates riveted upon the beams and half beams. The use of the partners is to enable the masts to be wedged at a deck and to distribute the strain and stresses which bear upon the wedging.

What is a floor and where situated?

They are deep vertical plates in the bottom of the vessel which

extend from bilge to bilge between the frame bars and reverse frames. The tops of the tanks are connected to the reverse frame on top of the floors.

What is ceiling (flooring)?

It is wood placed in the bottom of the holds which cover and protect the top of the tanks.

Ballast tanks.

They vary in size and are 3 to 4 feet deep—run fore and aft—and form an inner bottom to the ship. The door is closed with a dog or bridge, using white lead and screw, in the same way as a boiler door. Tank tops are tested by means of a head of water above the tank top which is equal to the full height of the water line of the ship when loaded.

Where are breast hook plates fitted?

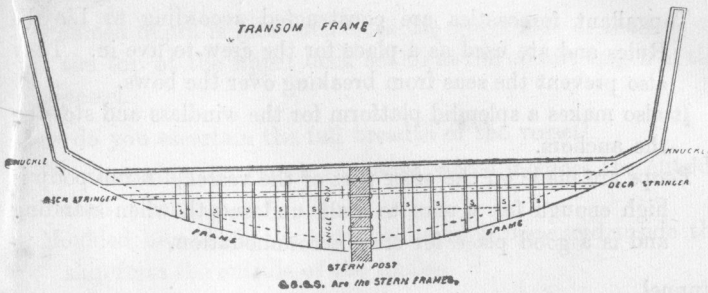
In the bows to strengthen and connect the stringers and stringer plates; the two sides of the vessel are connected by "breast hooks," and when used in the stern to connect the stringers they are called "crutches." Breast hooks are also fitted at the extremities of bilge keelsons, side stringers, etc.

Where are panting beams fitted?

In the bow of the vessel, viz., one panting beam on the foreside of the collision bulkhead and two abaft it. These beams are connected to the stringer by gusset plates and riveted to the frames. Panting beams are required to stiffen the bows, on account of strain and stress from heavy seas, and they are also fitted in the stern of the vessel.

What is a transom?

It is a vertical plate fitted at the stern of the vessel and extends across the ship, to which the upper part of the stern post is joined. The transom frame is the first frame in the ship which extends round the transom floor to the transom beam. The stern frames are connected to the transom frame. The



S.S.S. Are the STERN FRAMES.

upper deck stringer plate is carried round the stern, and connected to the transom floor by an angle iron, and riveted to the top of the beam on the fore side of the transom. The transom plate (floor) and frame support the overhanging counter aft.

Describe cant frames.

Cant frames are fitted round the upper part of the stern or counter, and joined to the transom floor with brackets, and cant upwards to the cant beams which extend from the transom beam.

What is the oxter plate?

The oxter plate is that plate that is underneath the counter at the head of the rudder post, and joins the flat part of the stern to the upper strake riveted on to the stern post.

What is a breast hook?

The plate that joins the extremities at the bow and stern.

What is a web frame?

It is a wide plate connected to the shell plating by a frame angle bar and stiffened on the inner edge by double reverse angle bars.

How are bulwark ports fitted?

They are hinged ports which open outwards and consequently free the decks from heavy seas.

Topgallant forecastles are constructed according to Lloyd's Rules and are used as a place for the crew to live in. They also prevent the seas from breaking over the bows.

It also makes a splendid platform for the windlass and stowing the anchors.

Poops are made on the after part of the vessel. A full poop is high enough for a man to walk underneath when standing and is a good place for crew accommodation.

Funnel.

The funnel is used for making a draught, also to carry up the smoke. It is fitted on top of the uptake of the smoke boxes of the boilers. On account of expansion the funnel guys should be set up easy after steam is got up.

Oxter plates are the curved plates above the screw aperture and below the counter.

Rider plate is one which rests upon another such as is seen on top of keelsons.

The margin plate forms the boundary between the tanks and bilges; it is riveted to the floors by means of angle bars, and the lower part to the shell plating by means of an angle bar.

The bilge bracket is made fast to the margin plate and extends up the side usually twice the depth of floor.

What is meant by the length of the vessel over all, and between perpendiculars?

Length over all is the full length of the vessel over all from stem to stern.

The length between perpendiculars is found by measuring from the fore part of the stem post in a line with the upper deck beams to the after part of the stern.

How do you find the depth of the hold?

The depth of the hold is found by measuring from the top of the beams amidships to the top of the tank or ceiling.

Moulded depth is measured from the upper side of the keel to the top of the upper deck beams at the middle length of the vessel.

How do you ascertain the full breadth of the vessel?

By measuring the extreme breadth which includes the outside shell plating.

Moulded breadth is the extreme breadth measured inside the ship from the outside of the frames.

What is register tonnage?

It is the internal measurement of the vessel in cubic feet.

Dues are paid on the net register tonnage.

How many cubic feet are there in a ton register?

One hundred.

What is the difference between gross and net register tonnage?

Gross tonnage is the complete measurement of the vessel inside, in cubic feet, which includes engine room, saloons, forecastle, etc., divided by 100.

Net register tonnage is found by deducting the unearning space of the vessel from the gross tonnage, such as engine room, cabins and crew spaces, etc.

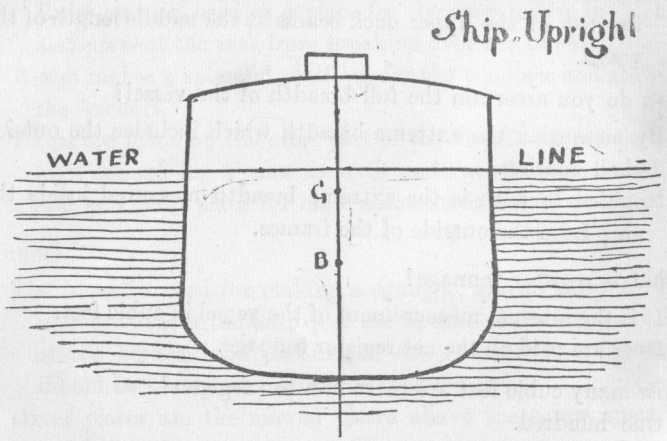
In what part of the vessel is the official number and register tonnage inserted?

It is cut on the inside of the after part of the main hatch coamings.

What is deadweight?

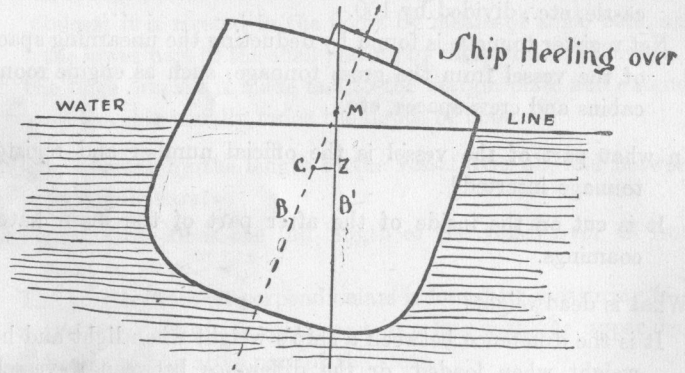
It is the difference between a ship's weight when light and her weight when loaded, or the difference between a vessel's weight when light and her weight at any other draught.

STABILITY.



G centre of gravity. *B* centre of buoyancy.

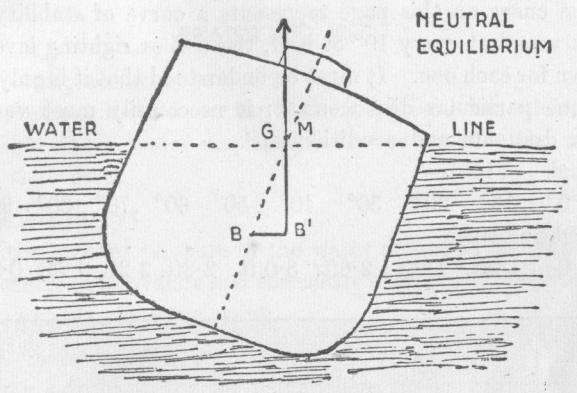
When a ship is upright the centre of gravity and the centre of buoyancy are in the same vertical line and there is no righting lever.

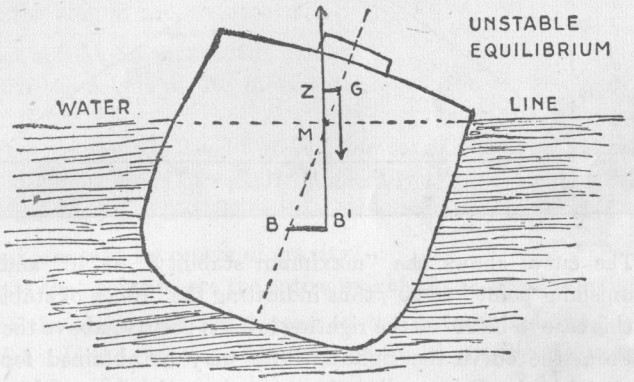


M metacentre.
G centre of gravity.
GZ righting lever.
B centre of buoyancy when upright.
B^1 when heeling over, the new centre of buoyancy which has moved towards the right.

Buoyancy means floating effort, and it requires 35 cubic feet of salt water to be displaced to bear 1 ton of weight.

Centre of gravity.—The point at which a body will balance, acted on by its own weight.





Centre of buoyancy.—A point at the centre of the immersed part of a ship's hull.

Metacentre.—The point where a vertical line passing through

the centre of buoyancy intersects the centre line of the ship. In the diagram, M is the metacentre and $G\,M$ is the metacentric height.

STABILITY CURVE.

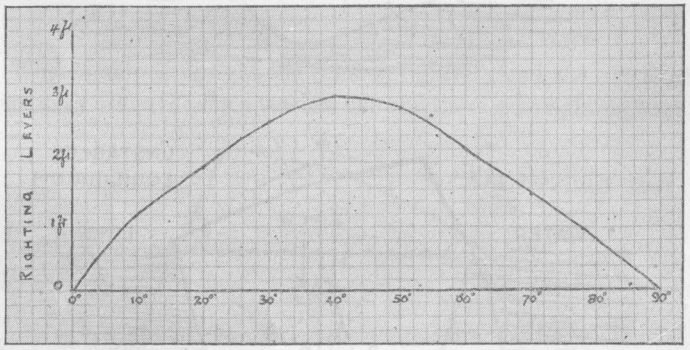
The curve on this page represents a curve of stability drawn for a vessel at every 10° of heel, the $G\,Z$ or righting lever being known for each one. It must be understood that it is only correct for one particular displacement; it necessarily must vary with other draughts and conditions.

Angles of heel—

0° 10° 20° 30° 40° 50° 60° 70° 80° 90°

Righting lever—

0 1·2ft. 1·9ft 2·6ft. 3·0 ft. 2·8ft. 2·2ft. 1·5ft. 0·8ft. 0



The curve shows the "maximum stability" at 40° and the "vanishing point" at 90°, thus indicating the "range of stability" in this case to be 90° as the righting lever is positive above the line.

From the curve the righting lever may be obtained for any angle of heel. Draw a line, from the base line, perpendicularly upwards, to meet the curve: then follow out to the righting levers.

Example.—Required the righting lever for 24° of heel.

Answer.—2·2 feet.

When the vessel's G is below M she is said to be of stable equilibrium.

When G and M coincide she is in a state of neutral equilibrium.

When G is above M the vessel is unstable in equilibrium.

STABILITY, ETC.

What is displacement?

It is the amount of water the vessel displaces when afloat. Or weight of the water displaced is always equal to the weight of the vessel.

What is buoyancy?

It is the upward pressure of the water acting on the ship.

The centre of buoyancy and the centre of displacement in a ship are exactly the same point.

What is metacentre?

When a ship has a list the point where the vertical line passes the new centre of buoyancy and intersects the centre line of the ship is the metacentre.

What is G.M. or metacentric height?

It is the height of the metacentre above the centre of gravity of the ship.

The metacentric height (G.M.) for cargo steamers varies for different kinds of vessels. Generally the metacentric height is from 1 to 2 feet above the centre of gravity of the ship.

What is meant by centre of gravity?

It is that point where the entire weight of the vessel is acting.

Does the ship's stability depend on the metacentre?

Yes. If the point is above the centre of gravity the vessel is stiff. If below, the ship is tender.

If the metacentre is too high, the vessel will roll and be extra stiff in bad weather. If low, the ship will be tender and unstable.

How often are official surveys held?

No. 1 survey at the expiry of four years; No. 2 at eight years; No. 3 at twelve years.

When the vessel is in dry dock what would you carefully examine?

The rudder, propeller, tail-end shaft, tanks, ship's cables, and the vessel's bottom.

How can you find the metacentric height (*G M*)?

From the curve of transverse metacentres supplied by the shipbuilder, or by calculation—by heeling the vessel by means of a heavy weight.

What do you mean by the term righting moment?

It is the power a vessel has of coming back to an upright position when heeled over.

What produces stability?

Great beam and heavy weights placed in the bottom of a vessel. The two factors in stability are weight and leverage. In a light vessel, to prevent rolling, ballast should be raised up in the holds and trimmed into the wings.

How will a ship behave with too much stability?

She will behave badly and have quick, jerking movements.

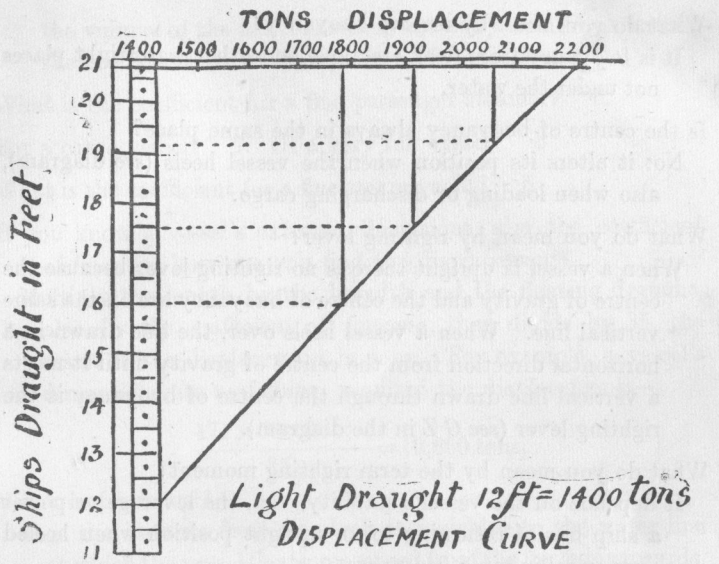
How will you prevent over stability?

I would consider the type of vessel, also the nature of the cargo, and then have the cargo placed so that the ship will not be over tender, or have too much stability.

What is a displacement curve?

It is a curve supplied by the shipbuilder, from which you can find by inspection the displacement in tons for any mean draught.

When loading or discharging you can find how much cargo you have taken on board, or discharged by the mean draught and the displacement curve.



Required the displacement with the ship's mean draught at 16 ft. Draw a horizontal dotted line on the scale from 16 ft. to the curve, from this point draw a perpendicular line to the top of the scale and the displacement is read off, viz., 1800 tons.

Required the displacement at 17 ft. 6 ins. The dotted line is drawn to the curve, then the vertical line to the top, viz., 1920 tons.

Required the displacement at 19 ft. 3 ins.

Ans. 2060 tons.

Tons per inch is found by calculating the displacement for a foot of the depth at the particular draught the ship is floating, and divide by 12, the result is the increase or decrease of the displacement for 1 inch alteration in draught.

How is a vessel's displacement found?

When the vessel is afloat it can be ascertained by *Simpson's Rules*. By the rules you find the total displacement in cubic feet, which divide by 35 for sea water and 36 for fresh water; the result is the tons displacement.

What do you mean by reserve buoyancy?

It is buoyancy from deck erections and other watertight places not under the water.

Is the centre of buoyancy always in the same place?

No; it alters its position when the vessel heels (*see* diagram), also when loading or discharging cargo.

What do you mean by righting lever?

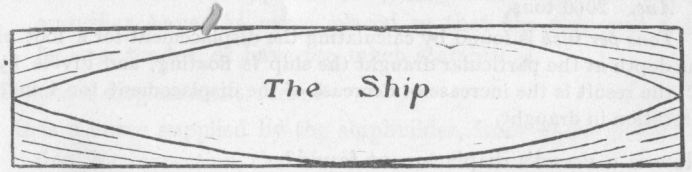
When a vessel is upright there is no righting lever because the centre of gravity and the centre of buoyancy are on the same vertical line. When a vessel heels over, the line drawn in a horizontal direction from the centre of gravity until it meets a vertical line drawn through the centre of buoyancy is the righting lever (*see G Z* in the diagram).

What do you mean by the term righting moment?

It depends on the vessel's stability, viz., the leverage or power a ship has of returning to an upright position when heeled over or rolling in a heavy sea.

How is the righting moment calculated?

It is reckoned in foot-tons or inch-tons. The rule is to multiply together the numbers which represent the units of distance by the units of weights. Example: a force of 200 tons acting with a leverage of 6 feet will give 1200 foot-tons. If expressed in inches it will be $200 \times 6 = 1200$ inch-tons.



What is a coefficient of fineness?

It is the fractional part (generally expressed in decimals) which the volume of displacement bears to a circumscribed block. When the vessel is complete you can see that a great deal of

the volume of the block has been cut away and this is termed the coefficient, or the comparison of fineness.

What is the coefficient for a fine passenger steamer? ·6.

For a cargo vessel? ·7 Or a very full vessel? ·8

What is the coefficient for a fine steam yacht? ·5.

If you know a vessel's extreme dimensions, also the coefficient of fineness, how can you find the displacement?

Multiply the length by the breadth and the floating draught, also by the coefficient of fineness, then divide by 35, the result is the displacement in tons. For example, a vessel's dimensions are as follows, required the displacement:—

$$\frac{471 \times 56 \times 28 \times \cdot 6}{35} = 12{,}660 \text{ tons.}$$

What is freeboard?

It is the distance from the deck at midships to the water line at which the vessel floats, measured from the deck downwards.

What is the use of a vertical scale?

By the scale you can read at a glance the total displacement—viz., the deadweight and the corresponding freeboard—at any particular mean draught.

Are floor plates the same depth fore and aft?

No. Floor plates are deeper at transverse bulkhead frames in order that the bulkhead plates may be lapped and riveted to them. Also at the ends of the vessel they are made deeper and spaced closer than amidships.

What parts of a vessel contribute principally to her transverse strength?

Transverse bulkheads, beams, frames, decks, etc. Intercostal keelsons, etc., add to the longitudinal strength of a vessel.

What is the main source of a vessel's strength?

Beams, frames, decks, shell plating, etc.

What is the difference between an ordinary and "cellular" double bottom?

In an ordinary double bottom there is a clear run in the frame spaces between the centre keelson and the margin plate of the ballast tank.

The cellular double bottom is fitted with intercostal plates between the floors which divide the double bottom into small compartments (cells), hence the name "cellular" double bottom.

How will you preserve the material of an iron or steel vessel from wasting by corrosion?

I would have the iron scraped, cleaned, and dry, then paint with red and white lead and oxide of zinc.

How do you paint the ship's bottom below the water line?

Upon the outside of a vessel below the water line the paint or composition is intended to act as an anti-corrosive and also to prevent "fouling" (*i.e.*, to prevent the growth of marine plants and animals). The bottom should be well scraped, clean and dry, then coated over with anti-corrosive paint, and finish with a coating of anti-fouling material.

If a steamer was stranded on a sandy beach what would you be careful about when working the engines?

On account of sand getting into the condenser I would be very careful to avoid using the engines as little as possible, and only if it was absolutely necessary.

ENGINES.

What is horse power?

Horse power is the power required to raise a weight of one pound 33,000 feet in one minute.

What is nominal horse power?

It is a term used to denote the size of an engine.

What is indicated horse power?

It is the horse power developed in the cylinders of an engine.

What is effective horse power?

It is the actual horse power transmitted to the propeller, and about one-tenth less than indicated horse power.

What is a Diesel engine?

An internal combustion engine—no boilers—and it works on crude oil, it occupies less space, and is more economical than the steam engine and boilers.

TURBINES.

A turbine can be most concisely described as a horizontal water wheel, such as drives the machinery of some mills in country districts, and which is really a water turbine. The steam turbine is just the same in principle, but steam takes the place of water, and force of impact alone, and not force combined with weight —as in the case of the water turbine—makes the wheel go round.

In the bottom of the vessel there is a big drum placed, which revolves on a shaft, whence the motive power is applied direct to the propeller.

This drum is enclosed within a cylindrical case, and on the outside of the drum and on the inside of the case, facing and nearly touching each other, are rows of thousands of tiny projecting blades. The blades on the drum are so shaped, slantingly, that if you were able to blow hard enough at them a rotary impulse would be applied to the drum, and it would move round. The steam is let into the cylinder through a hole at the side direct from the boiler, and, acting upon the movable blades, causes the drum to revolve at a very rapid rate.

The fixed blades on the inside of the cylinder, which almost touch the others, slant in the opposite direction, and they are there for the purpose of securing the efficiency of the turbine, and making the steam act upon it in the right way. When the steam

first enters the cylinder it meets a ring of these fixed blades, by which it is deflected so that it strikes the adjoining ring of moving blades at the proper angle for imparting the rotary impulse. When the steam leaves these blades it has naturally been deflected, and the second ring of fixed blades is interposed, these directing the steam on to the second ring of moving blades. Precisely the same process is carried out with the many succeeding rings of guide and moving blades.

Of course, the rush of steam between these two sets of blades makes the drum, and consequently the shaft to which it is attached, revolve and so drive the vessel ahead. The steam first enters the high pressure and then passes to the low pressure turbine, and on to the condenser, then back to the boilers.

Astern Turbines.

To go astern, a separate turbine, with blades angled the opposite way, is fixed on the same shaft, the stern drum being placed abaft the go-ahead turbine.

BALLAST TANKS.

Most modern cargo steam vessels are constructed to carry water ballast when necessary, the water being contained in double bottoms, deep tanks and fore and after peak tanks.

Cellular double bottom tanks are formed by the shell plating and the inner bottom. The inner bottom is supported by the floors and inner longitudinal girders, the sides of the tanks are formed by the margin plates. The margin plates extend from the tank top to the shell plating, the frames being cut to allow this to be done, and are connected to the shell by a continuous watertight angle bar.

Deep tanks are usually placed at either end of the engine room and stokehold. The transverse bulkhead at each end of these water carrying spaces is specially strengthened with heavy vertical and horizontal stiffeners, and these tanks are also fitted

with watertight hatchways. Water ballast or ordinary cargo can be carried in them as desired.

In all tanks, sounding pipes and air pipes are fitted; and should the air pipes be fitted with caps these must be removed when filling or emptying the tanks to allow for the egress or ingress of air. The depth of water in tanks and bilges is ascertained by means of a sounding rod, and as the constant dropping of the rod is liable to damage the shell plating a small doubling plate should be fitted under each sounding pipe.

FILLING AND EMPTYING TANKS.

The filling and emptying of tanks is under the charge of the engineers who receive their instructions from the deck department. Situated in the engine room is a distribution chest whereby the engineer can allow water to flow from the ship's side sea valve to any compartment or pump from any compartment.

Double bottom tanks do not (as a rule) require pumping up as they are situated below water level, but deep tanks may require to be pumped up till they are full.

It is usual for the after tanks and bilges to drain forward and the forward ones to drain aft, and the ends of the suction pipes are generally in these positions.

The ends of any bilge suction pipe terminates in a strum or rose box, being formed of perforated metal, the perforations of which are to be at least twice the area of the suction pipe. These rose boxes are necessary to keep solid matter from entering the pipes and choking the pumps.

Cellular double bottoms are also of great value in the event of the outer bottom being damaged as they assist a vessel in remaining afloat.

BULKHEADS.

Bulkheads are the vertical partitions which subdivide the inferior of a vessel either transversely or longitudinally. In merchant vessels the bulkhead subdivisions are nearly all made

transversely, except in some large steamers. In warships, longitudinal watertight bulkheads are frequently employed, fitted with watertight doors, which are supposed to be always ready to close in a moment's time and thus keep the damaged compartment from affecting the vessel's efficiency. Subdividing into many compartments is an important feature in war vessels, and the principle is adopted in the double bottom space, and also throughout the whole ship to the iron decks above the water line.

A warship is constructed so that in the event of damage from shot or shell, one or even more compartments may be full of water, and at the same time the vessel will have sufficient buoyancy for safety.

Lloyd's Rules regulate the number of bulkheads, according to the length of the vessel. In steamers 400 feet and under 470 feet in length, seven watertight bulkheads are required to be fitted and extended to the upper deck; as the length of the vessel increases so will the number of the bulkheads.

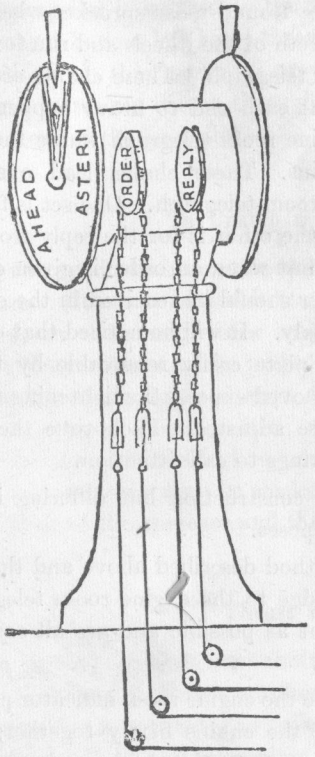
Small steamers have usually four transverse watertight bulkheads, one of these being situated at a short distance from the stem and stern, and one at each extremity of the engine room space.

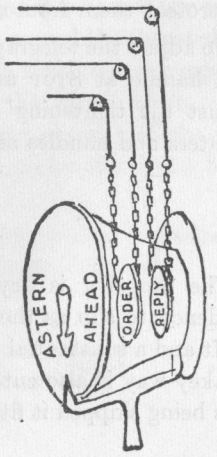
Sailing Vessel's Bulkheads

Sailing vessels have usually only one bulkhead, which, of course, is fitted transversely, situated at a short distance from the bow. It is generally known as the collision bulkhead, because in the event of collision and serious damage to the bow, it will prevent the vessel from sinking.

ENGINE ROOM TELEGRAPH.

The telegraph for communicating orders for the engine room is situated on the bridge and in many cases is duplicated, one being in the port wing of the bridge and the other in the starboard wing. Inside the dial casing are two sprocket wheels, keyed on to the





axle which carries the handle. Round these sprocket wheels are flat chains which engage the teeth of the wheels and run for some length down the pillar of the telegraph. These chains are connected by tightening screws at each end to heavy copper wire, which is led down to the engine room telegraph where they are again connected to flat chains. These chains lead over the sprocket wheels in the engine room telegraph. One set is for the signal from the bridge whilst the other is for the reply from the engine room. It is essential that when an order is given on the bridge telegraph the same order should be received in the engine room and the same with the reply. It will be noticed that on the telegraph pedestal there is a plate easily removable by taking out a few screws, and when removed exposes the tightening screws by which the telegraph can be adjusted. Each time the telegraph handle is turned a bell rings to call attention.

Other telegraphs similar in construction but differing in the dials are used for docking purposes.

The diagram shows the method described above and the way the wires are led from the bridge to the engine room telegraph. These wires are taken as direct as possible and are all cased in to protect them from damage.

To adjust the telegraph, place the engine room indicator pointer and handle at STOP and lash the chains firmly together; then adjust the tightening screws on the bridge telegraph until all pointers and handles are at STOP.

PROPELLER.

The propeller is keyed on the shaft and this prevents any tendency to slip as the shaft revolves. A keyway is cut in the shaft and a substantial key is fitted in this recess. A corresponding key-way is also cut in the boss of the propeller so that when it is being shipped it fits exactly over the key in the shaft.

The propeller is secured to the shaft by means of a large nut, which must have a left hand thread for a right handed propeller and *vice versa;* this, again, is prevented from working loose by having a cotter pin driven through the shaft or being screwed on to the boss of the propeller.

To Unship a Propeller.

Rig two good purchases, one from each quarter, in line with the aperture. (It is not advisable to use the eye bolts riveted to the counter, as these may draw and cause considerable damage.) Attach the purchases to the propeller by having chain slings made fast to the boss, figure-of-eight fashion and take the weight, keeping an equal strain on both purchases. When the engineers have disconnected the locking nut and withdrawn the tail end shaft, one purchase may be slacked away so as to bring the propeller clear of the aperture and then lowered into the dry dock.

Thrust Block.

The part of the shaft next abaft the engines is named the crank shaft; connected to this is another length named the thrust shaft. This usually has a number of collars which revolve in corresponding grooves in a heavy bearing named the thrust block. The forward thrust when the engines are going ahead and the after drag when they are going astern is taken up by the thrust block otherwise the engines would be damaged.

The thrust block must be very strongly secured to the structure of the vessel to withstand the great strain put upon it.

Pitch and Slip of a Propeller.

The pitch of a propeller is the distance it would go ahead in one revolution, when there is no slip—or supposing it to revolve in a solid instead of in water.

The slip of the propeller is caused by the water giving way to the pressure of the propeller as it drives the steamer ahead; the distance gone ahead at each revolution is thus not equal to its pitch—the distance lost in this way is the slip of the propeller, *i.e.*, the slip is the difference between the actual speed of the vessel and the speed of the propeller.

Propellers.

Example on the pitch and slip.

A propeller has a pitch of 20 feet and it makes 70 revolutions per minute. The recorded speed by the log is 12 knots. Find the slip of the propeller.

Pitch of propeller	20 feet
Revolutions per minute	70
Speed of propeller per minute	1400 feet
	60
Speed of propeller per hour	84,000 feet

Divide by 6080)84,000(13·81 knots

6080

23,200
18,240

49,600
48,640

,9600

Speed of propeller	13·81 knots
Speed of ship	12·00 ,,
Slip in knots	1·81 ,,

The slip is more frequently expressed as a percentage of the speed.

Express the above slip as a percentage of the speed.

13·81 : 1·81 : : 100 : x

1·81
100

13·81)181·00(13·1 per cent.
1381

4290
4143

·1470

Steam Winches.

Steam winches require careful attention at sea, and they should be overhauled, cleaned, oiled and kept covered over; before entering port open the cocks and run off any water which may have condensed in the cylinders and pipes, turn the steam on gently and allow it to blow through the cocks; have all the parts carefully oiled; the handles, brakes, clutches and steam cocks should all work smoothly without any friction. During frosty weather when in harbour, in the night-time easy steam should be kept on the winches, disconnect the gear and keep the exhaust cocks open; this will prevent the pipes from bursting.

Steering Gear

At sea the steering gear should receive special attention; the various sheaves, leads, and pins should be oiled frequently, and

the steam engine which works the steering gear should at all times be in good working order. The hand gear should be ready for immediate use in the event of breakdown.

The Windlass.

After leaving port the windlass should be cleaned, oiled, and covered over, so that it may be protected from rain and salt water, and consequently kept free from rust.

The anchors should also be examined to see that the shackles and pins are all properly secured.

Corrosion.

To prevent corrosion in a new vessel the inside surface of the shell and frames are covered over with a mixture of cement and fresh-water sand up to the turn of the bilge, and paint of extra good quality on all other parts of the vessel. Iron and steel should be cleaned, and when dry covered over with two good coats of white lead. Iron and steel work, if kept in good order, will last for many years. A great many patent compositions are in use for ship's bottoms, to prevent fouling from barnacles; but if you have no patent compositions on board a good substitute for covering bare spots on the bottom is a mixture of tallow and white lead.

Leaving Port.

Before leaving dock or an anchorage, the engines should be worked ahead and astern, the steam steering gear examined and put hard over both ways; the steam whistle and engine-room telegraph should be in working order, log line and lead line on deck all ready for use. The compasses should be overhauled, and in the night-time the lights trimmed, also the charts and deviation book handy for reference. The anchors and windlass should be all cleared, cork fenders, heaving lines and a boat all ready for running lines, etc., derricks all sent down and cargo

gear made up snug and stowed away, the decks cleared, stores stowed away, and all movable gear about the decks securely lashed; the ship's draught taken fore and aft—the figures on the stem and stern are 6 inches in length, and the draught is taken from the lower edge of the figures.

PROPELLER AND HELM.

(Screw Race.)

A right-handed screw propeller revolves from the port to the starboard side of the vessel during the upper part of its revolution while the steamer is going ahead. A left-handed screw works in the opposite direction.

Vessel Steaming Ahead.

With a right-hand screw, and headway, under starboard wheel, the vessel's head will go to starboard. With port wheel her head will cant to port.

When a vessel is steaming full speed ahead and the wheel is put hard over, the steamer's stern will move much quicker than her head; a long heavy vessel retains her momentum longer than a small vessel, and consequently has headway for a considerable time after the engines are stopped.

Vessel Going Astern.

Under starboard wheel her head will cant to port; port wheel, her head will cant to starboard.

Right-Hand Screw Propeller.

The effect of the propeller only on the ship's head is as follows:—With the wheel amidships, steamer going ahead, head cants to port; steamer going astern, head cants to starboard.

To turn a steamer short round:—With a right-handed propeller

she will turn easily and quickly with her head to starboard. Put the vessel full speed ahead and wheel hard-a-starboard the screw race will now press against the rudder, and the steamer's head will cant to starboard; immediately she gathers headway, stop the engines, shift the wheel, and at the same moment reverse to full speed astern. When she gathers sternway, stop, then full speed ahead, wheel hard-a-starboard—and so on until the vessel is round. By promptly attending to the helm, and working the engines ahead and astern, the vessel can be turned round in her own length.

To turn a twin screw steamer round:—Put the wheel amidships, then with one engine going ahead and the other astern the steamer's head will turn on that side on which the screw is going astern. To turn short round, the speeds of the propellers must be carefully regulated so as to prevent the steamer from getting headway.

ANCHORING STEAMER.

The advantage of mooring a vessel is that the ship takes up less room in swinging to the tide or wind, as she remains between her two anchors.

Single Anchor.

A vessel lying at single anchor is much safer than when moored, as she is always riding in a direct line from her anchor, no matter in which direction the wind is blowing; the cable therefore receives the strain in the best way. If it commences to blow hard, let go the second anchor, and by veering out cable bring them both ahead; a steamer can also go easy ahead and therefore ease the strain on the cables and windlass.

In a sailing vessel the best way to ease the cables is to have a coir spring from the quarter made fast to the cable, then as the ship pitches and heaves to the sea the coir spring gently gives with the motion of the vessel and relieves the cables.

To Come to Anchor in an open Roadstead.

Approach the anchorage under easy steam until in position, when the engines should be rung astern to stop her way. When moving astern let go the working anchor, stop the engines and pay out the cable. (Three or four times the depth is usual, but this depends on the nature of the bottom and also the weather conditions.) Then check the windlass to bring the ship up, using the engines if required.

Note.—In the Northern Hemisphere the working anchor is the port one. This is because in practically all cases of bad weather the wind shifts to the right and should it become necessary to let go the second anchor they will be clear of each other when the wind shifts. In the Southern Hemisphere the case is opposite.

To get under weigh. Put the windlass in gear, send a hand to the chain locker and heave away, notifying the bridge as the shackles come inboard. When the anchor is apeak, go slow ahead on the engines, call the hand out of the locker and heave the anchor up to the pipe. Put the brake on the windlass and put the windlass out of gear, thus having the anchor ready for letting go should the occasion demand it.

Note.—The anchor is apeak when the cable is up and down: the anchor is away when it is off the bottom.

In bad weather a ship will lie better with one anchor with a long scope of cable as the bight (or catenary) of the cable acts as a spring, and takes the strain.

Vessels are moored with two anchors so that they swing in a small compass such as is required in rivers and congested roadsteads.

By being moored with two anchors means that one anchor is used for the flood tide and one for the ebb.

To come to anchor entering a river with the flood tide.

When approaching the anchorage, stop the engines to take the way off the ship, come astern on the engines to cant the vessel's

head to starboard, then ahead with the helm hard astarboard to bring the vessel head to tide. It may be necessary to drop the starboard anchor underfoot to help the ship swing. When head to tide slack away the cable until you have sufficient length, using the engines to bring her up. Screw up the windlass, and as in all cases of anchoring take bearings of objects ashore so that it can be observed whether the vessel is dragging.

Coming in against the ebb tide to make a running moor with 45 fathoms on each cable.

Reduce speed on approaching the anchorage and when in position let go the weather anchor, paying out to 90 fathoms when the ship should have lost her way. Stop engines. Let go the second anchor paying out as she drops astern with the tide and heaving in the slack of the first cable until the 45 shackle of each cable is in a handy position near the windlass. Screw up the windlass.

Note.—The shackles are kept handy the windlass ready for clearing hawse.

Coming into a river on the flood tide to moor the ship with 60 fathoms on one anchor and 45 on the other.

As in the case of coming to a single anchor, turn round to stem the tide and let go the starboard anchor paying out to 105 fathoms, come ahead on the engines and let go the second anchor, slacking away on the second and heaving in the first cable, until the required shackles are handy the windlass. (It is usual to have the longer cable for the ebb tide as it invariably runs stronger than the flood.)

To clear hawse. (Take the turns out of the cables.)

There are various methods of doing this. One good way is to heave the turns close up to the pipe, pass a good manilla lashing round both cables just below the turns, and for security have a wire rope shackled on to the cable, which is to be unshackled,

below the turns and make fast on deck. Slack up the cable you are not riding by and unshackle. Bend a line on to the end and pay it out through the pipe. Now have a hook rope on each side of the stem and by alternately hooking these ropes to the cable the turns are easily hove clear. Bend the line which is through the pipe to the end and heave it inboard, and shackle on again. Cast off the preventer wire and slip the lashing.

Moored, to get under weigh.

Heave in the cable you are not riding to, slacking away on the riding cable until the lee anchor is hove up. Then heave away on the riding cable, going ahead on the engines when up and down.

To Anchor in Deep Water.

Reduce speed on approaching the anchorage, and when the ship is stopped have the windlass in gear and heave out the cable until the anchor is within a few fathoms of the bottom, then put the windlass out of gear and let go paying out to the required length.

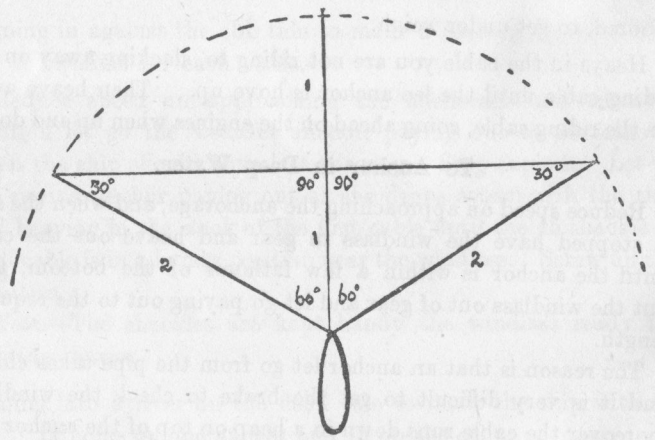
The reason is that an anchor let go from the pipe takes charge and it is very difficult to get the brake to check the windlass; moreover the cable runs down in a heap on top of the anchor and will practically be sure to give you a foul anchor. Should this happen the ship would undoubtedly drag in a strong tide or breeze.

To clear a foul anchor, *i.e.*, when the crown comes up to the pipe first, pass a wire rope round the crown and make fast inboard. Walk back the windlass gently so as to let the wire take the weight. Slack the cable well out. Bend another line to the cable and heave the turn clear from the crown; unbend it and heave away the cable, slacking away the wire and then unbending it. Heave anchor up the hawse pipe.

In the event of being moored in a roadstead and the wind blows hard across the anchors so that the cables lead broad on each bow, the cables must be slacked well away so that they lead

well ahead. The holding power is thus greatly increased and the strain on the cables greatly reduced.

When a ship has her anchors broad on each bow it is easy to calculate the approximate percentage of pull in the right direction, *i.e.* ahead. For example:—Let us assume a vessel to be riding head to wind and the spread between the anchors is 120°.



As the secant of 60° is 2, the effective pull on each is 1. Therefore one anchor leading ahead with the same amount of cable will be equal in value to both the others broad on the bow.

To keep a clear hawse, endeavour before the last of the tide to sheer the ship, by means of the helm, in the direction in which you desire her to swing. Then, should she remain sheered, the new tide, catching her quarter, will swing her in the right direction. It will be seen that wind must play a large part in this endeavour, as when the tide is slack she must inevitably become wind rode.

When anchored in shoal water and bad holding ground, it is essential that a long scope of cable should be used so that the pull on the anchor is nearly horizontal. At slack water, should

there be a light breeze or calm, it is advisable to heave short until the ship swings to the new tide when the required length can again be slacked away. By so doing you will in all probability keep your anchor clear. Should the chain be allowed to remain slack it is likely to be drawn across the anchor and foul it.

To lay out a kedge anchor against the tide.

Coil the warp in the boat all clear for running. Lower the anchor down so that the crown and arms rest on some planks placed athwartships, the stock being up and down over the stern. Secure it in this position. See that the buoy rope is bent on. This is clove hitched to the crown of the anchor, a turn each side of the shank and two half hitches. Pull out to the required position. Have the warp bent on to the ring of the anchor and pay out sufficient so that the anchor will reach the bottom. Stream the buoy; see all hands clear of the warp and then by means of the planks turn the anchor outboard. Drop back with the tide to the ship, paying out the warp and pass the end aboard.

To lay out a kedge anchor with the tide.

Hang the anchor over the stern of the boat by means of a slip rope. Bend on the buoy rope and warp. Row out to the position in which you want the anchor, letting the warp be payed out from the ship. When in position stream the buoy and let go the slip rope.

In the event of the kedge wire carrying away and the anchor being buoyed, it may be recovered by means of the buoy rope. Should there be no buoy rope, get two boats away and with a length of wire or chain sweep in the vicinity until you foul the anchor. Keeping the two parts taut, let the boats come together and run a large shackle down over both parts. Coming, as it will, to rest on or near the anchor will prevent the sweep wire or chain becoming detached, and the anchor can be lifted. A handy billy made fast to the wires will make the task of lifting the anchor a fairly simple matter.

SHIP MANOEUVRING.

In coming alongside always have the anchors ready for use, even if they may not be required.

Coming in against the ebb tide to make fast alongside a wharf, head up, starboard side to the wharf.

As the ship approaches the berth have the engines eased down until slightly ahead of it, then stop your engines and run out a head line and a back spring from forward, also a stern line. She will then drop into position alongside, and can be made fast with springs and breast ropes in addition to the head and stern lines.

It is practically the same if coming alongside with the port side to the wharf. The action of the propeller on the vessel in coming astern must be carefully considered.

If a strong breeze should be blowing on to the wharf it may be found necessary to drop the off-shore anchor to ease her alongside.

Coming in against the ebb tide to go alongside a wharf on your starboard hand, port side to the wharf.

Come up under very easy steam until abreast of the wharf. Run out a good wire rope from aft to the wharf and make fast. Go ahead gently on the engines to keep her stern from touching, and the tide will swing the ship round. Get the after moorings away, also some from forward; as she drops alongside heave all taut and put out all moorings.

Here again it may be prudent to drop the off-shore anchor to ease her alongside.

Coming in on the flood tide, to go alongside a wharf on the starboard hand, head out ready for sea.

Some distance below the berth, stop the engines and turn the ship round head to tide, if necessary dropping the starboard anchor underfoot to check her round. When head to tide, heave up the anchor (if used) and steam slowly against the tide alongside,

running away head and stern ropes to assist. Then run out usual mooring ropes.

Coming in on the flood tide, to go alongside a wharf, starboard side to and head up.

At a good distance below the berth, have the engines stopped or put astern to take the way off the ship and drop up with the tide with the ship's head canted out slightly. Run away stern lines and a head rope. Come astern on the engines and she will drift alongside. Heave taut and pass out all moorings.

Coming in on the flood tide, to go into dock on the starboard hand.

Practically, in all cases, the vessels bound out of the dock on that flood tide lock out before the inward bound ships enter the dock. Thus the tide is usually nearly, if not quite, slack.

Round the ship to using the starboard anchor (if necessary). Let the ship drop up above the dock entrance, then come ahead, running out a check rope from the port bow to the dock head. Go ahead slowly and check her into the entrance to the lock.

Riding at anchor to the flood tide below a dock on the starboard hand of the river, with no steam on the main engines, to enter the dock.

Heave short, port the wheel to cant the ship's head to port and dredge up to the upper knuckle; pass ropes ashore and heave alongside. Heave up the anchor. Pass a good wire rope from the port quarter to the dock head and spring the vessel ahead, not checking the port bow rope until the vessel's half length is abreast of the upper knuckle, then check her round and into the lock.

With steam on the main engines, the anchor could be lifted and the vessel dropped up.

To get under way from a berth, port side to and head out, flood tide.

Pass a good spring, from aft, well ahead, and also a breast

rope from the port bow. Heave well taut. Take in all other moorings. When all ready, ease the breast rope and the tide should force the head away from the wharf. Check the breast rope to bring the stern away from alongside. Come ahead on the engines, take in the breast rope and then the spring.

If you were starboard side to the wharf the procedure is similar, excepting your lines are passed ashore on the starboard side.

Lying alongside a wharf, head up stream, starboard side to the wharf, to get away to sea, flood tide.

Pass a good spring ashore from well forward on the starboard side to well aft, and heave taut. Pass a good breast rope ashore from the starboard quarter. Take in all other moorings. See all ready, ease the breast rope and her stern will cant out by the effect of the tide. If not, come slowly astern on the engines; the propeller, working left handed, will have the required effect. Check the breast rope slightly and the bow should also come out. Then let go breast rope, come astern on the engines and the vessel will turn round into mid-stream. Let go the forward spring and manipulate the engines ahead and astern to stem the flood tide. The starboard anchor could be dropped underfoot if necessary to assist the ship to swing.

If alongside, port side to, head up, to get away on the flood tide.

Run out a good spring from forward, leading aft, also a good after breast rope. Take in other moorings. Ease the after breast rope to get the stern away from the wharf. When well off, let go the breast rope, ease away forward spring and come astern into mid-stream, letting go port anchor underfoot to assist in swinging head to tide, at the same time using the engines as required. When head to tide go ahead on the engines, heave up anchor and proceed.

To make fast to a buoy, coming in against the ebb tide.

Approaching the buoy, ease engines well down to little more

than stemming the tide. Run out a good line to the buoy and heave taut. Stop engines. Next pass out heavy wires or chain cable to the buoy.

If mooring to a buoy with the cable, after having passed a good line to the buoy to keep the ship in position, hang off the bower anchor, pass a runner down through the buoy ring (towards the ship), bend it on to the cable a few links up, and heave it out to the buoy. Pass the shackle through the ring of the buoy and shackle on to the end of cable. Ease away the runner and unbend it and take the weight on the cable. Heave in buoy rope.

To get away from the buoy, moored with the cable.

Heave short, pass a good rope through the ring of the buoy (towards the ship) and make fast aboard. Heave well taut. Ease the cable to let the slip rope take the weight. Pass a runner through the ring and bend on to the cable so as to take the weight off it, and unshackle. Heave the end up and shackle on to the anchor. When all ready, let go the slip rope and heave it in, as it is rove as suggested it will come clear.

To moor stern on to the quay in an open harbour (such as in the Mediterranean).

Proceed under very easy steam to nearly abreast of the berth and well off-shore. Let go the off-shore anchor, stop the engines and check her round somewhat. Let go the second anchor. Run away a good stern rope and heave astern, paying out cable until near enough to get out the stern moorings; hold on the cables. When all the after mooring ropes are fast, it may be advisable to heave in some cable on both anchors.

A good way is to pass 12 or 15-inch coir ropes through the quarter pipes, and wire ropes from the after warping chocks, crossing them, *i.e.* the starboard rope to lead to port and the port rope to starboard. Have plenty of parcelling or rounding on the coir ropes to prevent chafing.

DREDGING.

A vessel can be dredged up or down stream by heaving short on the cable and allowing the tide to carry the ship along with it. Should the vessel sheer too much to one side, veer some cable and hold on to it so as to straighten her up, when the cable can be again hove short and she will again be carried with the tide.

To go alongside a wharf, no steam on the main engines, heave short, put the helm over to sheer towards the wharf; when nearing it slack out more chain and run the lines ashore, easing the ship alongside by means of the cable.

DEEP SEA SOUNDINGS. (STEAMER.)

With a patent sounding machine on board it will not be necessary to stop; but if using the ordinary lead ease down and stop. Have the lead armed and passed along the weather side to the bow, and the crew stationed with small coils of the line, ready for letting go. When all is ready, heave the lead, and pass the word along "watch there watch." Two casts should be taken so that the soundings will be correct and reliable.

In rough weather, or when the vessel is making leeway, it is advisable to pass the lead line from the weather side round to the lee bow; by the time the line reaches the bottom you will obtain upright soundings on the weather side.

In foggy weather soundings should be frequently taken and the nature of the bottom noted, so that the vessel's position may be traced on the chart.

MAN OVERBOARD. (STEAM VESSEL).

Throw a life-buoy over as near to the man as possible, and stop the steamer; if he has fallen over on the starboard side put the wheel hard-a-starboard, the vessel having headway will turn round towards the man in the water; the watch on deck will have the

boat lowered away, and before she takes the water the painter should be passed forward and made fast. Also, in the hurry do not forget to put the plug in. In the daytime a man aloft can, if necessary, direct the boatman. In the night-time a life-buoy, with a patent light attached, should be thrown over as soon as the alarm is given.

COLLISION.

In the event of collision, stop the engines, close all sluices and get the pumps to work, sound all the holds and find which compartment is making most water.

The inrush of water may be stopped by placing sails or awnings over the damaged part. If making much water the main engines may be used as a pump; near the land the vessel may be beached, or the boats all lowered to save life. If you run down a vessel end on and damage her badly, do not go astern; steam slow ahead and keep in contact with her until the crew and passengers, if any, are rescued, by lines over the bow, or by boats.

If possible, it is the duty, at all times, of one vessel to assist the other.

BOARDING A VESSEL.

To rescue the crew from a vessel in heavy weather requires considerable skill. Steam to windward of the vessel in distress, then get out the lee lifeboat (the boat should board the vessel on her lee side), then steam round to leeward so that the lifeboat can return with a fair wind and sea. Before lowering the boat pass the painter forward, and see that all the gear is in order; then use oil and give the officer in charge of the boat instructions to use oil when he attempts to rescue the crew.

TOWING AT SEA.

Steam to windward, and float a lifebuoy to the other vessel with a thin line attached, then a larger line, until the tow line is passed.

In many cases of towing broken-down vessels, unnecessary damage is done by not in the first place putting out sufficiently strong gear, and in the next by not taking precautions to prevent sudden jerks and extreme strains to the towing hawser.

In the first place, in the open ocean the tow line should have a very long scope, and be attached to the cable of the ship being towed, and the vessel towing should make fast the towing wire to a long bridle of several parts of manila or hemp hawser, which in their turn should be made fast to several sets of bollards.

It is an excellent plan to attach a weight to the centre of the tow line, and the handiest way of doing this is to put a length of cable in the centre. This is easily done in the following way:—The vessel that is to tow the other sends her hawser to the vessel to be towed; the latter makes fast the end to her chain cable, and veers away till the first shackle comes up, disconnects that shackle and attaches her hawser, and veers away till the length of cable is well in the centre of the tow line. By this means sudden jerks on the tow line are avoided, the weight in the centre tending to equalise the strain throughout when there is much motion owing to a seaway.

For steering purposes, if a broken-down steamer has lost her rudder and the engines are in working order, make fast astern and allow the disabled steamer to use her engines going ahead.

A very good alternative method of towing to that given above was once seen by the writer.

Having lost our propeller when 1200 miles to the westward of Ireland, we were taken in tow by another vessel of about the same tonnage.

We had two wire ropes, a 6-inch and a 4½ inch, led from the rescuing vessel's after warping chocks and both connected to our starboard cable (the anchor having been unshackled). About 90 fathoms of cable was then slacked away and the cable then fixed in the chain controller. This proved an excellent way of dealing with the situation, the catenary of the chain making a very

good spring. On making Queenstown we were enabled to heave short the cable and thus have a short tow rope for manoeuvring purposes.

QUESTIONS AND ANSWERS.

Steering Gear.

On board a steamer in narrow waters, if your steering chains snap, what would you do?

Stop the engines, connect the hand gear promptly, or if necessary let go the anchor.

Engines.

Your engines break down at sea, what would you do?

Hoist the regulation signal—by day, two black balls or shapes; by night, two red lights. Set all sail, and have the repairs done as soon as possible.

A CHAPTER ON SAILS

AND

THE MANAGEMENT OF SHIP'S BOATS

ALSO

SEAMANSHIP

INSTRUMENTS

AND

STOWAGE OF CARGO

SAILS.

It is only in exceptional circumstances that sails are carried on steamers nowadays, the enormous size of vessels being out of all proportion to the small amount of canvas that could be set on present day masts. Nevertheless seamen should have some knowledge of the subject, and for that purpose a few elementary particulars are given on fore and aft sails.

All staysails and trysails are roped on the port side, the reason being that the different parts of the sails are easily determined. Both staysails and trysails, although they appear to be triangular in shape, are not in reality as there is always a round to the foot, and in the case of staysails the luff is also rounded. This is to allow the sail to set and draw properly. Lugsails in lifeboats also have the foot rounded.

To Bend a Staysail.

Get the sail along to the stay, cast off the stops, flake the sail down on deck, tack up, head down, so that when bent the rope will be to port. Bend on the tack, then the hanks to the luff, working upwards to the head. Bend on the downhaul and halyards to the head cringle. Shackle the sheet to the clew cringle.

Shape of hanks for staysails.

The rovings or robands (lengths of spunyarn, sennit, or rope-yarns) are passed alternately, through the eyelet hole in the sail and the eyes of the hank.

To Set a Staysail.

Loose the sail, *i.e.* cast off the gaskets. (Gaskets are lengths of small line used for making the sail fast.) Let go the downhaul, haul aft the slack of the sheet (this must be on the lee side). Man the halyards, hoist the sail close up, flatten aft the sheet.

To Take in a Staysail

Man the downhaul. Let go the halyards, haul away on the downhaul, easing away the sheet as required. When hauled down snug, make it fast by passing the gaskets round it.

To Unbend it for putting away in the Sail Locker.

Cast off halyards, downhaul and sheet. Unbend the tack and rovings. Stretch the sail along the deck on the after leech, carry the tack of the sail across to the head so that the leech and foot ropes are together. Roll up snugly, stop it up with ropeyarns and put away in locker.

To Bend a Steamer's Hoisting Trysail.

When it is intended that a steamer shall carry sails the masts are usually fitted with a tee rail on the after part to allow the sail to travel up and down, and therefore it is often called a traveller.

Carry the sail along to the foot of the mast, cast off the stops and open out the sail, keeping the tack down, head up, rope to port. Bend on the halyards and downhaul to the head cringle; hoist away, guiding the hanks under and on to the traveller.

For this purpose the hanks are shaped as shown here, and are put through the eyelet holes in the luff of the sail. When all the hanks

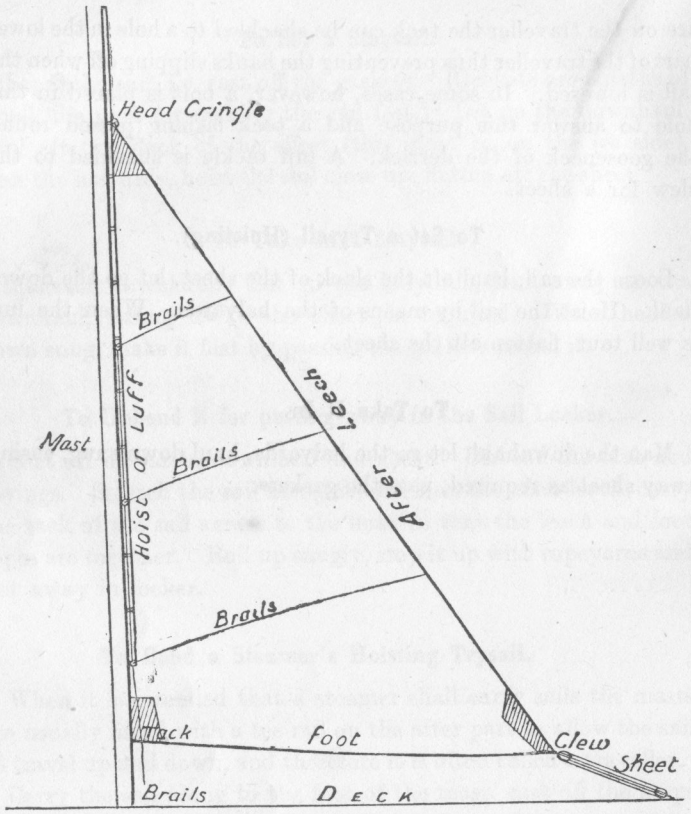
are on the traveller the tack can be shackled to a hole in the lower part of the traveller thus preventing the hanks slipping off when the sail is lowered. In some cases, however, a bolt is placed in this hole to answer this purpose and a tack lashing passed round the gooseneck of the derrick. A luff tackle is shackled to the clew for a sheet.

To Set a Trysail (Hoisting).

Loose the sail, haul aft the slack of the sheet, let go the downhaul. Hoist the sail by means of the halyards. When the luff is well taut, flatten aft the sheet.

To Take It In.

Man the downhaul, let go the halyards, haul down snug, easing away sheet as required, pass the gaskets.

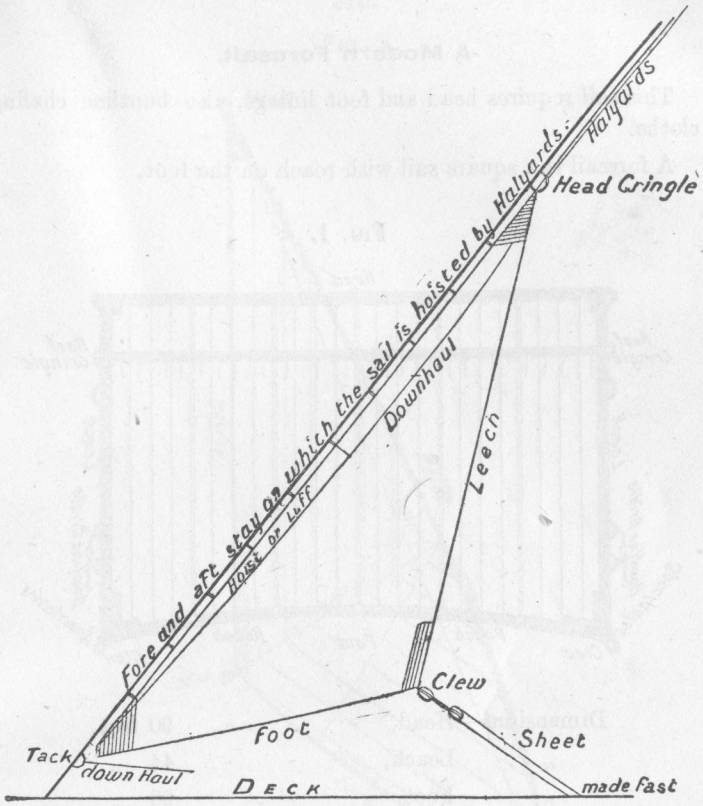


Steamer's Trysail.

Fore-and-aft sails are useful to steady a steamer, more so with a heavy swell or beam sea. This trysail may be bent on the mast, or hoisted from the deck by halyards on a traveller, which runs up on the after part of the mast. The brails are seized on the after leech of the sail, then rove through blocks on the mast and led down to the deck.

To set the trysail.—Loose the sail, let go the brails, and haul aft the sheet.

To take it in.—Man the lee brails, slack away the sheet, take in the slack of the weather brails, then make it fast with gaskets.



Staysail.

(1) To set it.—Let go the downhaul, haul aft the slack of the sheet, and hoist the sail up the stay by the halyards, when up, belay the halyards, and trim the sheet.

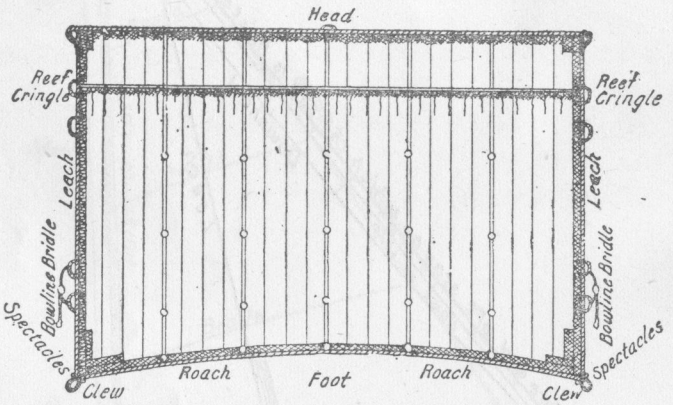
(2) To take it in.—See all clear, man the downhaul, let go the halyards, attend to the sheet, and when close down make fast the downhaul, and stow the sail.

A Modern Foresail.

This sail requires head and foot linings, also buntline chafing cloths.

A foresail is a square sail with roach on the foot.

FIG. 1.

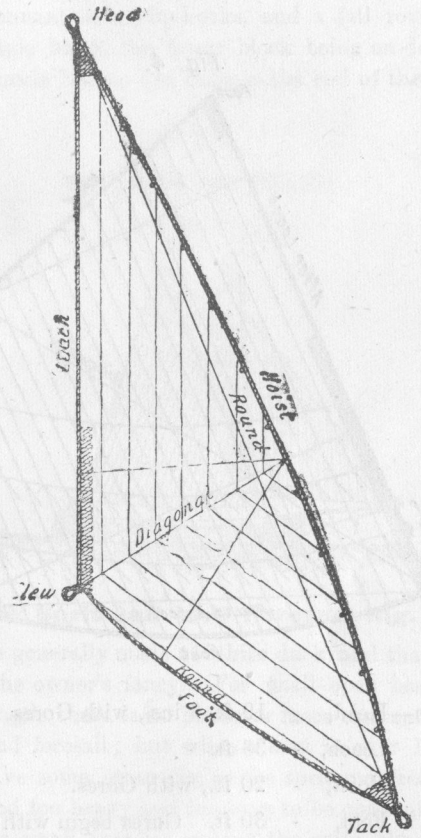


Dimensions—Head,	-	-	90 feet.
„ Leach,	-	-	44 „
„ Foot,	-	-	90 „

This foresail clews up to the yard arms, and has five buntlines rove through bull's-eyes, which are on the fore part of the sail. When hauled up snug the sail is practically furled. The clew-lines lead through a block at the quarter of the yard and down through a block at the yard arm, then through three lizards down the leach of the sail, and made fast on the clew.

Jib.

FIG. 2.



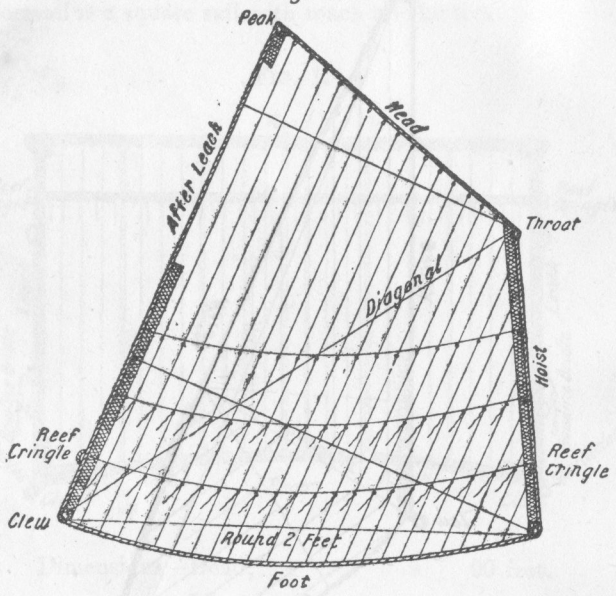
The gear on a jib is halliards, down-haul and sheet.

Dimensions—Hoist,	-	-	60 feet.
„ Leach,	-	-	41 „
„ Foot,	-	-	25 „

A Spanker.

Some ships have a standing gaff, and the sail is reefed from throat to clew on the after leach.

Fig. 4.



Dimensions—Head, - 19 ft. 6 ins., with Gores.
„ Leach, - 33 ft.
„ Hoist, - 20 ft., with Gores.
„ Foot, - 30 ft. Gores begin with 2 ins. up to 2 ft.
„ Diagonal, 33 ft. Throat to clew.
„ Reefs, - 5 ft. Seams, $1\frac{1}{2}$ ins.

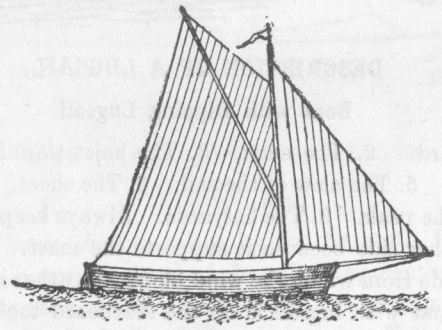
The hoist of the sail is secured with hanks to a traveller on the mast; the head is secured with hanks (or hoops) to the gaff.

Brails are made fast on the bight to the after leach, and the ends then rove through blocks on the mast down to the deck.

The gaff is kept in position by the vangs, one on each side of the gaff, a wire pennant with clip-hooks, and a fall rove through a double and single block, the lower block being on deck, and the clip-hooks are made fast on eye bolts at the end of the gaff.

THE SAILING BOAT.

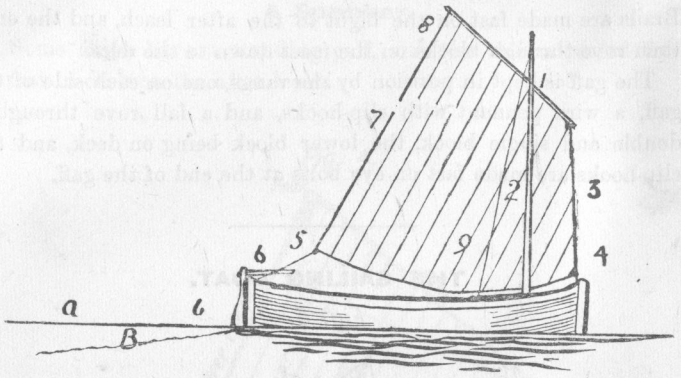
Fig. 5.



The Sprit-Sail and Foresail Rig.

Boat sails are generally made of white duck, and the rig depends very much on the owner's fancy. For small open boats about 15 or 16 feet in length there is no better or more convenient rig than the sprit-sail and foresail; but when a boat is over 18 feet it is preferable to have some other rig, as the sprit required to set the sail will be found too heavy and too long to be convenient.

The sprit is a small spar for setting the sail; the heel of the sprit being set in a strop, or a grommet formed into a snorter on the mast, and the top of the sprit set in the peak eye. The hoist of the foresail acts as a fore-stay; and a single small rope on each side of the mast, made fast to the gunwale, will be quite good enough for shrouds; however, the boat will sail better without them.



DESCRIPTION OF A LUGSAIL.

Boat with Dipping Lugsail.

1. The yard. 2. The mast. 3. The hoist (fore leech or luff). 4. The tack. 5. The clew of the sail. 6. The sheet. 7. The after leech. 8. The peak. 9. The halyards. Always keep the halyards on the weather side because it supports the mast. The weather side is the side from which the wind blows, the other is the lee side.

1. This boat with lugsail is on the starboard tack. *a b* is the fore and aft line, angle *B* is the leeway, looking over the stern the crooked line is the wake which the boat makes in the water.

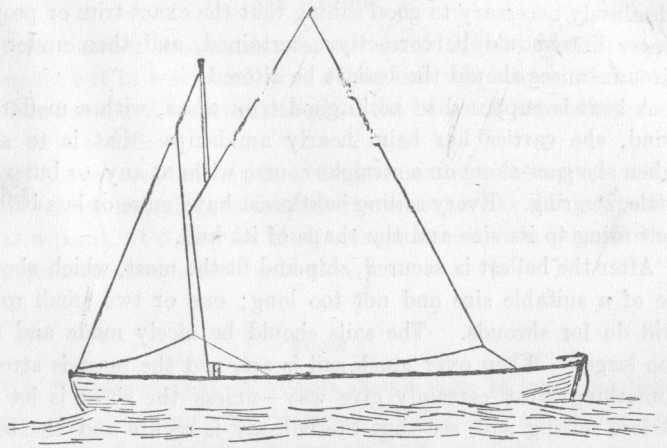
2. A boat is on the starboard tack when the wind is on the starboard bow; on the port tack when the wind is on the port bow. When the wind is abeam or abaft the beam the boat is free.

3. Two boats crossing. The boat which is on the port tack must keep out of the way of the boat on the starboard tack.

4. The boat which has the wind free (abaft the beam) must keep out of the way of a boat which is braced up on either tack.

5. Two boats on the same tack, to avoid collision the weather boat must give way.

6. The overtaking vessel keeps out of the way of the other vessel.



Lifeboat with Standing Lugsail and Jib.

Lifeboats, Etc.

For large boats the lug sail is by far the best. The ordinary lug needs no boom; the head of the sail being bent on to a light, stiff yard, the tack can be hooked on at the stem, and when the sail is set, have the halliards to windward, which will act as a stay.

Dipping the lug is a smart piece of seamanship. At the moment of coming about lower the halliards a little, slack the sheet, unhook the tack, and swing the fore part of the yard to the other side of the mast, then hook on the tack, set up the halliards, and haul aft the sheet. In rough weather lower the lug sail, unhook the yard from the traveller, and shift the sail whilst down.

Boat Sailing.

To trim a sailing boat is to stow the ballast so that the boat may sit upon the water in that position in which she may be sailed with the greatest safety, and at the fastest rate. It is

absolutely necessary to good sailing that the exact trim or proper water line should be correctly ascertained, and then under no circumstances should the ballast be altered.

A boat is supposed to be in good trim when, with a moderate wind, she carries her helm nearly amidships—that is to say, when she goes along on a straight course without any, or but very little, steering. Every sailing boat must have more or less ballast according to its size and the shape of its hull.

After the ballast is secured, ship and fit the mast, which should be of a suitable size and not too long; one or two small ropes will do for shrouds. The sails should be nicely made and not too large. When over much sail is set, and the mast is strong, something must certainly give way—unless the sheet is let go. Before setting sail, see that the bobstay is secure and the bowsprit bowsed down at the outer end; then unfurl the sails, bend on the halliards and sheets, and have all ready for hoisting.

Never climb the mast to do any work; it is much better and safer to unstep and lower it. Also avoid standing in a small boat; all the work required can be done in a sitting position.

The sails should be set flat and the sheets should not be made fast, unless in very fine weather. If a squall strikes you let go, or ease away the sheet. In a heavy squall put the helm down, lower away the halliards, etc. Always keep your boat well in hand and do not have too much sail set. If the breeze is freshening, you should take in sail or a reef when she begins to ship water. When coming to anchor round up to the wind, lower the sails, and let go the anchor.

Trim.

Cargo and ballast should always be stowed and secured amidships, so that it will not shift when the boat is rolling or pitching about in a sea-way. When loading, keep both ends clear and stow amidships, also trim the boat a little by the stern; the boat will then rise to the waves buoyantly.

Sea Anchor.

If the weather becomes rough, you should rig out a sea anchor. A bucket out to windward with a long line will keep her head to wind and sea, and with the use of oil the boat will ride safely and drift to leeward.

The proper sea anchor is a drogue made with canvas sewn round a large iron ring; the mouth or opening is like a bag tapered off to a point. Oil may be used with good results to prevent the seas from breaking over the boat.

Boats.

It is important that all vessels should have at least one boat swung out and ready for lowering. Unfortunately, boats are frequently neglected on board cargo vessels, but there is no reason why every vessel should not have one boat, fitted with lowering gear of the latest pattern, ready for instant use. Of course, during very bad weather it may be necessary to swing the boat inboard, but immediately the weather moderates the boat should again be swung out, the painter passed forward and made fast, the falls cleared for running, and at night a lighted lamp should be placed in the stern sheets.

Before proceeding to sea the boats should be overhauled, and lowered into the water with all gear complete. The davit falls, blocks, and lowering gear should be examined, and life lines fitted to each davit head, and two or three lines along the span, *i.e.*, the span rope or chain from one davit head to the other.

If you are cast adrift in a boat, thirst may be quenched considerably by keeping the underclothing wet with salt water.

During the voyage the boats should be examined frequently, and when the decks are being washed the hose should also be played all over the boats; in hot weather a little water should be left in the bottom, and all the boats protected with covers against the heat of the sun. The covers should be fitted so that they can

be cast off instantly, and the boat which is ready for an emergency should not be covered. This boat is secured as follows:—A large boom is lashed fore and aft, so that when swung out the boat rests against the boom; it is also fitted with self-detaching gripes, which are secured at the head of the davits, crossed outside the boat, then under the keel, and made fast inboard with a toggle which will not jam; two mallets are kept handy for knocking out the toggles, and immediately these are out the boat is free and ready for lowering.

The crew on board all ships, but especially on passenger vessels, should be exercised frequently at boat and fire drill, and the officer in charge of the boats should see that the boats' crew are familiar with the work expected of them. After boat drill all the life-saving appliances should be examined, *i.e.*, lifebelts, lifebuoys, etc.

It is the duty of every shipmaster to have boat drill, and also to have the life-saving appliances in good order.

Note.—The master of every British ship shall enter in the log-book every occasion on which boat drill is practised, and the life-saving appliances on board examined and found fit for use. If, on the inspection of the log-book, it is discovered that no drills have taken place, the master is liable to prosecution.

MANAGEMENT OF BOATS IN SURF

(Royal National Life-boat Rules.)

It may be accepted as a general rule that there is far more danger when running for the shore before a broken sea, than when being propelled against it, the danger consisting in the liability of a boat to broach to and upset, either by running her bow under water, or by her being thrown on her beam ends and overturned broadside on.

I.—In Rowing to Seaward.

The following general rules for rowing to seaward may therefore be relied on:—

1. If sufficient command can be kept over a boat by the skill of those on board her, avoid or "dodge" the sea if possible, so as not to meet it at the moment of its breaking or curling over.

2. Against a head gale and heavy surf, get all possible speed on a boat on the approach of every sea which cannot be avoided.

3. If more speed can be given to a boat than is sufficient to prevent her being carried back by a surf, her way may be checked on its approach, which will give her an easier passage over it.

II.—On Running before a Broken Sea, or Surf, to the Shore.

The one great danger, when running before a broken sea, is that of *broaching-to.* To that peculiar effect of the sea, so frequently destructive of human life, the utmost attention must be directed.

The cause of a boat's broaching-to when running before a broken sea or surf is that her own motion being in the same direction as that of the sea, whether it be given by the force of oars or sails, or by the force of the sea itself, she opposes no resistance to it, but is carried before it. Thus, if a boat be running with her bow to the shore, and her stern to the sea, the first effect of a surf or roller, on its overtaking her, is to throw up the stern, and as a consequence to depress the bow; if she then has sufficient inertia (which will be proportional to weight) to allow the sea to pass her, she will in succession pass through the descending, the horizontal, and the ascending positions, as the crest of the wave passes successively her stern, her midships, and her bow, in the reverse order in which the same positions occur to a boat propelled to seaward against a surf. This may be defined as the safe mode of running before a broken sea.

But if a boat on being overtaken by a heavy surf has not sufficient inertia to allow it to pass her, the first of the three positions above enumerated alone occurs—her stern is raised high in the air, and the wave carries the boat before it, on its front, or

unsafe side, sometimes with frightful velocity, the bow all the time deeply immersed in the hollow of the sea, where the water, stationary or comparatively so, offers a resistance, whilst the crest of the sea, having the actual motion which causes it to break, forces onward the stern, or near end of the boat. A boat will in this position sometimes, aided by careful oar-steerage, run a considerable distance until the wave has broken and expended itself. But it will often happen that, if the bow be low, it will be driven under water, when the buoyancy being lost forward, whilst the sea presses on the stern, the boat will be thrown (as it is termed) end over end; or, if the bow be high, or it be protected, as in most life-boats, by a bow air-chamber, so that it does not become submerged, that the resistance forward, acting on one bow, will slightly turn the boat's head and the force of the surf being transferred to the opposite quarter, she will in a moment be turned round broadside by the sea, and be thrown by it on her beam ends, or altogether capsized. It is in this manner that most boats are upset in a surf, especially on flat coasts, and in this way many lives are annually lost amongst merchant seamen when attempting to land, after being compelled to desert their vessels.

Hence it follows that the management of a boat, when landing through a heavy surf, must as far as possible be assimilated to that when proceeding to seaward against one, at least so far as to stop her progress shoreward at the moment of being overtaken by a heavy sea, and thus enabling it to pass her. There are different ways of effecting this object:—

1. By turning a boat's head to the sea before entering the broken water, and then backing in stern foremost, pulling a few strokes ahead to meet each heavy sea, and then again backing astern. If a sea be really heavy and a boat small, this plan will be generally the safest, as a boat can be kept more under command when the full force of the oars can be used against a heavy surf, than by backing them only.

2. If rowing to shore with the stern to seaward, by backing all

the oars on the approach of a heavy sea, and rowing ahead again as soon as it has passed to the bow of the boat, thus rowing in on the back of the wave: or, as it practised in some life-boats, placing the after-oarsmen, with their faces forward, and making them row back at each sea on its approach.

3. If rowed in bow foremost, by towing astern a pig of ballast or large stone, or a large basket, or a canvas-bag termed a "drogue" or drag, made for the purpose, the object of each being to hold the boat's stern back, and prevent her being turned broadside to the sea, or broaching-to.

Drogues are in common use by the boatmen on the Norfolk coast; they are conical-shaped bags of about the same form and proportionate length and breadth as a candle extinguisher, about 2 feet wide at the mouth, and 4½ feet long. They are towed, with the mouth foremost, by a stout rope, a small line, termed a tripping line, being fast to the apex or pointed end. When towed with the mouth foremost, they fill with water, and offer a considerable resistance, thereby holding back the stern; by letting go the stouter rope and retaining the smaller line, their position is reversed, when they collapse, and can be readily hauled into the boat.

Drogues are chiefly used in sailing boats, when they both serve to check a boat's way and to keep her end on to the sea. They are, however, a great source of safety in all boats, and the life-boats of the Royal National Lifeboat Institution are all provided with them.

A boat's sail bent to a yard and towed astern loosed, the yard being attached to a line capable of being veered, hauled, or let go, will act in some measure as a drogue, and will tend much to break the force of the sea immediately astern of the boat.

Heavy weights should be kept out of the extreme ends of the boat; but, when rowing before a heavy sea, the best trim is deepest by the stern, which prevents the stern being readily thrown on one side by the sea.

A boat should be steered by an oar over the stern or on one quarter when running before a sea, as the rudder will then at times be of no use. If the rudder be shipped, it should be kept amidships when a sea breaks over the stern.

The following general rules may therefore be depended on where running before, or attempting to land, through a heavy surf or broken water:—

1. As far as possible avoid each sea by placing the boat where the sea will break ahead or astern of her.

2. If the sea be very heavy, or if the boat be very small, and especially if she have a square stern, bring her bow round to seaward and back her in, rowing ahead against each heavy surf to allow it to pass the boat.

3. If it be considered safe to proceed to the shore bow foremost, back the oars against each sea on its approach so as to stop the boat's way through the water as far as possible, and if there is a drogue, or any other instrument in the boat which may be used as one, tow it astern to aid in keeping the boat end on to the sea, which is the chief object in view.

4. Bring the principal weights in the boat towards the end that is to seaward, but not to the extreme end.

5. If a boat, worked by both sails and oars, be running under sail for the land through a heavy sea, her crew should, under all circumstances, unless the beach be quite steep, take down her masts and sails before entering the broken water, and take her to land under oars alone, as above described. If she have sails only, her sails should be much reduced, a half-lowered foresail or other small headsail being sufficient.

III.—Beaching or Landing through a Surf.

The running before a surf or broken sea, and the beaching or landing of a boat, are two distinct operations: the management of boats, as above recommended, has exclusive reference to running before a surf where the shore is so flat that the broken water

extends to some distance from the beach. Thus, on a very steep beach the first heavy fall of broken water will be on the beach itself, whilst on some very flat shores there will be broken water as far as the eye can reach, sometimes extending to even 4 or 5 miles from the land. The outermost line of broken water, on a flat shore, where the waves break in 3 and 4 fathoms of water, is the heaviest, and therefore the most dangerous, and when it has been passed through in safety the danger lessens as the water shoals, until, on nearing the land, its force is spent and its power harmless. As the character of the sea is quite different on steep and flat shores, so is the customary management of boats on landing different in the two situations. On the flat shore, whether a boat be run or backed in, she is kept straight before or end on to the sea until she is fairly aground, when each surf takes her further in as it overtakes her, aided by the crew, who will then generally jump out to lighten her, and drag her in by her sides. As above stated, sail will in this case have been previously taken in if set, and the boat will have been rowed or backed in by oars alone.

On the other hand, on the *steep* beach it is the general practice, in a boat of any size, to retain speed right on to the beach, and in the act of landing, whether under oars or sail, to turn the boat's bow half round towards the direction from which the surf is running, so that she may be thrown on her broadside up the beach, where abundance of help is usually at hand to haul her as quickly as possible out of the reach of the sea. In such situations, we believe, it is nowhere the practice to back a boat in stern foremost under oars, but to row it under full speed as above described.

IV.—Boarding a Wreck, or a Vessel, under Sail or at Anchor, in a Heavy Sea.

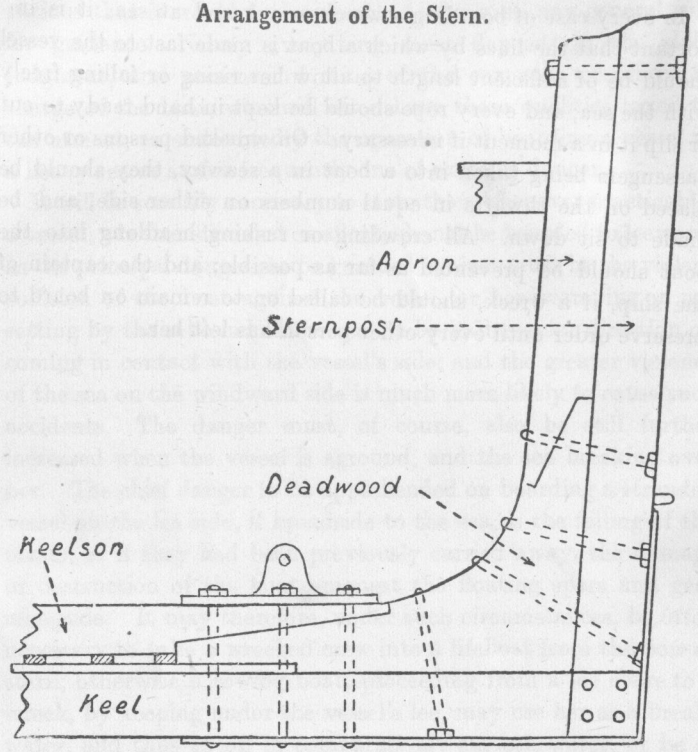
The circumstances under which lifeboats or other boats have to board vessels, whether stranded or at anchor, or under way, are so

various that it would be impossible to draw up any general rule for guidance. Nearly everything must depend on the skill, judgment, and presence of mind of the coxswain or officer in charge of the boat, who will often have those qualities taxed to the utmost, as undoubtedly the operation of boarding a vessel in a heavy sea or surf is frequently one of extreme danger.

It will be scarcely necessary to state that, whenever practicable, a vessel, whether stranded or afloat, should be boarded to leeward, as the principal dangers to be guarded against must be the violent collision of the boat against the vessel, or her swamping or upsetting by the rebound of the sea, or by its irregular direction on coming in contact with the vessel's side; and the greater violence of the sea on the windward side is much more likely to cause such accidents. The danger must, of course, also be still further increased when the vessel is aground, and the sea breaking over her. The chief danger to be apprehended on boarding a stranded vessel on the lee side, if broadside to the sea, is the falling of the masts; or if they had been previously carried away, the damage or destruction of the boat amongst the floating spars and gear alongside. It may therefore, under such circumstances, be often necessary to take a wrecked crew into a lifeboat from the bow or stern; otherwise a rowing boat, proceeding from a lee shore to a wreck, by keeping under the vessel's lee, may use her as a breakwater, and thus go off in comparatively smooth water, or be at least shielded from the worst of the sea. This is, accordingly, the usual practice in the rowing lifeboats around the United Kingdom. The larger sailing lifeboats, chiefly on the Norfolk and Suffolk coasts, which go off to wrecks on outlying shoals, are, however, usually anchored to windward of stranded vessels, and then veered down to 100 or 150 fathoms of cable, until near enough to throw a line on board. The greatest care under these circumstances has, of course, to be taken to prevent actual contact between the boat and the ship, and the crew of the latter have sometimes to jump overboard, and be hauled to the boat by ropes.

In every case of boarding a wreck or a vessel at sea, it is important that the lines by which a boat is made fast to the vessel should be of sufficient length to allow her rising or falling freely with the sea; and every rope should be kept in hand ready to cut or slip it in a moment if necessary. On wrecked persons or other passengers being taken into a boat in a seaway, they should be placed on the thwarts in equal numbers on either side, and be made to sit down. All crowding or rushing headlong into the boat should be prevented as far as possible; and the captain of the ship, if a wreck, should be called on to remain on board to preserve order until every other person has left her.

Arrangement of the Stern.



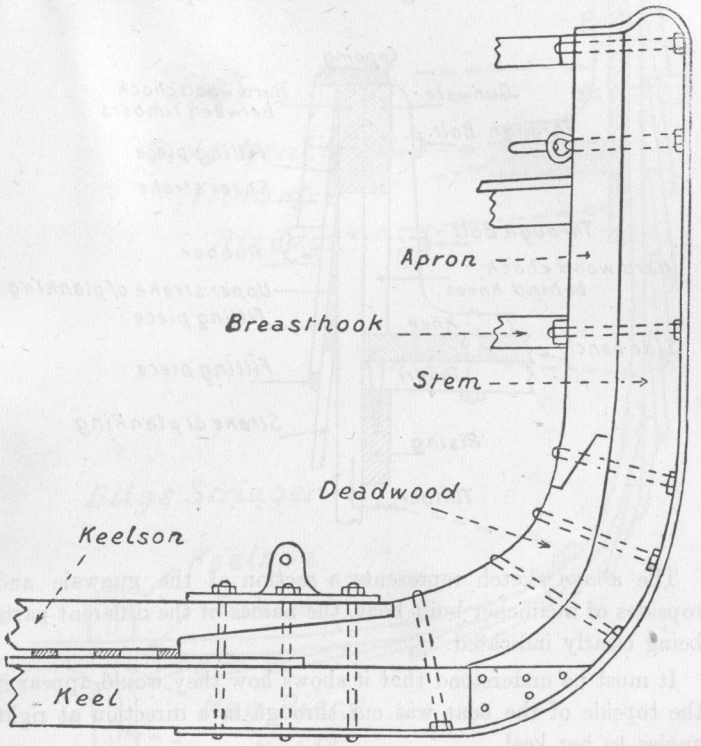
The construction of the stern is very similar to that of the stem.

The line separating the apron from the sternpost indicates the position of the rabbeting for taking the ends of the planking.

Note the iron stern band. This is fitted from a point just under the lower gudgeon round the keel, under the keel, and extends far enough forward to take the three through bolts securing the lifting hook attachment.

The three shaded pieces are the timbers which lie on top of the hog piece but underneath the keelson.

Arrangement of Stem, Apron, Etc. Construction of the Fore End of a Boat.



The small double line on the stem is the **iron stem band.**

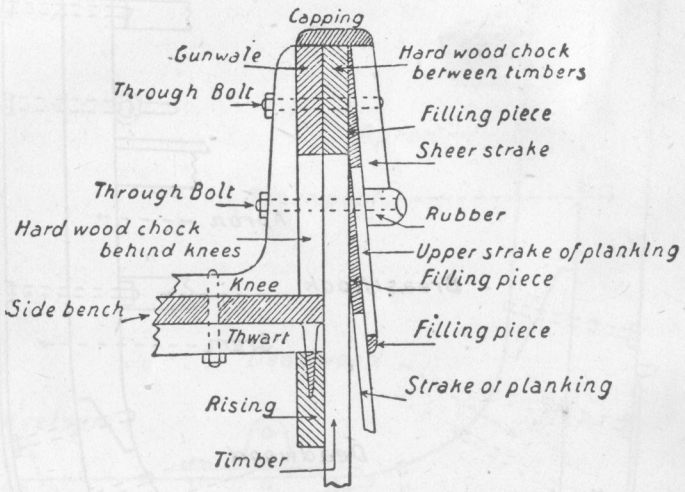
The line separating the apron from the stem indicates the position of the **rabbeting** for taking the ends of the planking.

The three small shaded pieces are the **timbers.**

The fitting with the three through bolts is for the **attachment of the lifting hook.** Note that in this case the stem band is extended far enough aft to take the heads of these bolts. If not extended so far, a separate plate must befitted.

Details of Boat Construction.

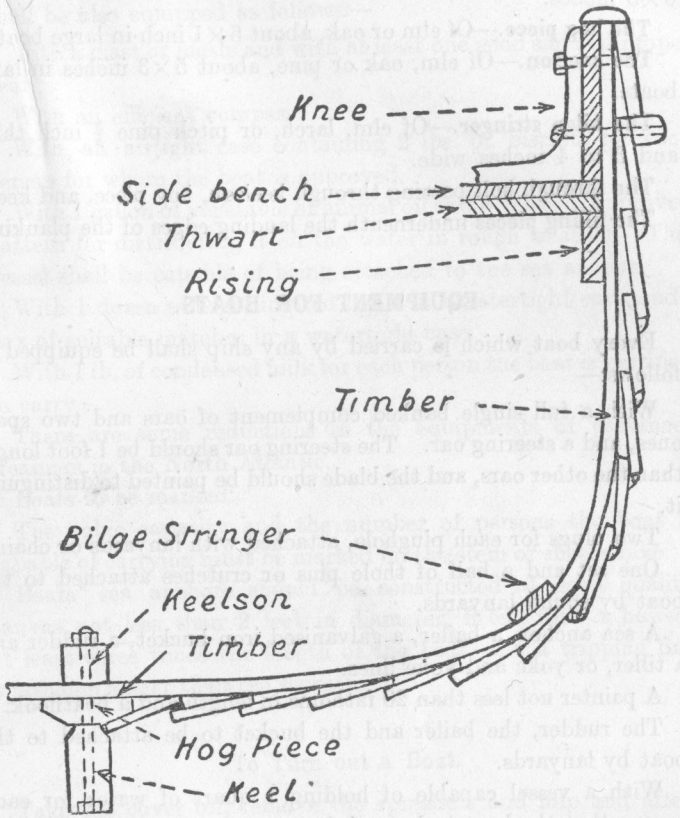
Section Through Gunwale and Topsides



The above sketch represents a section of the gunwale and topsides of a clincher built boat, the names of the different parts being clearly indicated.

It must be understood that it shows how they would appear if the topside of the boat was cut through in a direction at right angles to her keel.

Half Midship Section of Clincher Built Boat.



Note the following parts:—

The timber.—Generally of American elm, ash or oak. In boats of 29 or 30 feet in length the size would be about $1\frac{1}{2} \times 1$ inch. Except at the ends of the boat, this is fitted in **one piece from gunwale to gunwale.**

The keel.—Of American elm or oak required to be fitted in one

piece. In boats of 29 or 30 feet in length the size would be about 6×3 inches.

The hog piece.—Of elm or oak, about 5×1 inch in large boats.

The keelson.—Of elm, oak or pine, about 5×3 inches in large boats.

The bilge stringer.—Of elm, larch, or pitch pine ¾ inch thick and 3 to 4 inches wide.

The through bolt passing through keelson, hog piece, and keel.

The filling pieces underneath the landing edges of the planking.

EQUIPMENT FOR BOATS.

Every boat which is carried by any ship shall be equipped as follows:—

With a full single banked complement of oars and two spare ones, and a steering oar. The steering oar should be 1 foot longer than the other oars, and the blade should be painted to distinguish it.

Two plugs for each plughole, attached with lanyards or chains.

One set and a half of thole pins or crutches attached to the boat by sound lanyards.

A sea anchor, a bailer, a galvanised iron bucket, a rudder and a tiller, or yoke and yoke lines.

A painter not less than 20 fathoms in length and a boathook.

The rudder, the bailer and the bucket to be attached to the boat by lanyards.

With a vessel capable of holding 1 quart of water for each person that the boat is deemed fit to carry. This vessel shall be kept filled with fresh water and provided with a dipper with lanyard. With 2 hatchets, one at each end of the boat, attached with lanyards.

With a line securely becketted round the outside of the boat.

With an efficient lantern trimmed, with oil in its receiver sufficient to burn for 8 hours.

In addition to the above equipment, all foreign-going ships shall be also equipped as follows:—

With a mast or masts and with at least one good sail and proper gear.

With an efficient compass.

With an airtight case containing 2 lbs. of biscuits for each person for whom the boat is approved.

With 1 gallon of vegetable or animal oil and a vessel of approved pattern for distributing it on the water in rough weather. This vessel shall be capable of being attached to the sea anchor.

With 1 dozen self-igniting red lights in a watertight case, and a box of suitable matches in a watertight case.

With 1 lb. of condensed milk for each person the boat is certified to carry.

There are some reductions in the equipments of passenger steamers in the North Atlantic.

Boats to be marked.

The cubic capacity and the number of persons the boat is capable of carrying must be marked on the stem or sheerstrake.

Boats' sea anchors should be constructed of good quality canvas not less than 2 feet in diameter, fitted with a hawser at least three times the length of the boat, and a tripping line 2 fathoms longer than the hawser.

To Turn out a Boat.

Take the cover off, remove the spreaders and fore and after. Pass the painter (or better still a boat rope) outside the davits, forward. Put the plug in. Cast off the outboard gripes and chocks. Take the weight on the falls, let go inboard gripes. Launch the boat aft, push the bow out, launch forward and push the stern out. Square the boat up with the davit guys. Ship the rudder and tiller. (There are two of the crew in the boat.) Lower away, keeping the after part of the boat a little lower than

the fore part so that it takes the water slightly before the fore part. Unhook the after tackle first.

To Set the Sail. (Dipping Lug.)

Step the mast and clamp it. Set up the shrouds if the mast is fitted with them. If not, always bear in mind the halliards must be kept to windward to help support the mast.

Have the yard (with sail bent on) arranged to leeward of the mast. Hook the tack to the horse on the weather bow; hook the traveller to the strop round the yard and have the sheet led aft ready for hauling aft.

Hoist the yard until the luff rope is taut and belay the halliards. Haul aft the sheet. You may catch a turn with it, but under NO consideration should it be made fast. It will depend on circumstances as to how flat the sheet must be. The closer you wish the boat to sail to the wind the flatter must be the sheet.

To Tack a Boat with a Dipping Lug.

Keep the sail quite full so as to gather good headway. Ease the helm down. When the sail shakes, lower away (right down). Unhook the tack and strop on the yard, launch aft and then forward on the other side of the mast. Again hook on tack and traveller, and the wind being on the other bow reset the sail as before.

To Wear a Boat with a Dipping Lug.

Put the helm up, ease off the sheet. As the wind draws aft, lower away and gather the sail in. Shift the sail across to the other side of the mast, rehook, and when the wind is on the other quarter set the sail again, hauling in the sheet and meeting the boat with the helm as she comes to the wind.

To Set a Standing Lug.

Step the mast (as before explained). Make the tack fast the mast, just by the thwart. Hook on the halliards, have the sheet

ready for hauling aft. Now hoist the yard close up till the luff is quite taut, then haul aft the sheet.

Nearly always a standing lug is carried in connection with a jib. This should be set after the lugsail. To do so, hook the tack to the stem, hoist the sail up until the luff rope is taut, then flatten aft the sheet.

To Tack, with a Standing Lug and Jib

Get good headway on the boat, ease the helm down and at the same time ease off the jib sheet. When the sails are shaking, pass the lug sheet over to the opposite side, and haul the jib sheet out to windward to help box the head off. When the lugsail fills, haul aft the lee jib sheet.

In many cases of going about it is often necessary to get a lee oar out to help pull the bow round, or the steering oar may be used to great advantage.

Gybing a Boat.

This term is used when the wind is brought from one quarter to the other by putting the helm up. It should never be attempted with a dipping lug, as the sail if gybed would be on the after part of the mast. In a boat fitted with a standing lug it is a practical manoeuvre, providing the wind is not strong.

To gybe a boat, put the helm up, ease off the sheet. When the wind draws aft, round in the sheet smartly and let the sail blow out on the other side, easing away the sheet gently so as not to bring a sudden strain on the mast. Pass the jib sheet over. As the boat comes up, haul in lugsail sheet and meet her with the helm.

To Reef a Lugsail.

Ease the helm down so as to take the weight of the wind out of the sail. Lower the yard right down, pass the tack and sheet through their respective cringles in the luff and leech. Gather the foot of the sail up (do not roll it), and tie the reef points round it. (Use reef knots.) Set the sail again.

To Shake out a Reef.

Ease the helm down as before. Lower the sail down, cast off the reef points. Come up the tack and sheet from the cringles. Hook on the tack and set the sail again.

In Squally Weather, Sailing Close Hauled.

Should a squall strike the boat, ease the helm down to take the force of wind out of the sail; stand by to let the sheet go if necessary.

If with the Wind well Free.

Keep the boat away well before the wind, easing off the sheet. If necessary, lower away.

BOATS.

The cubic capacity of every boat must be at least 125 cubic feet.

Lifeboats of Class 1.

1. Every boat shall have a mean sheer at least equal to 4 per cent. of its length.

2. The air-cases of every boat shall be so placed as to secure stability when fully laden under adverse weather conditions.

3. Internal buoyancy appliances shall be constructed of copper or yellow metal of not less than 18 ozs. to the superficial foot, or of other approved material.

Class 1. (a). Lifeboats with Internal Buoyancy Appliances only.

4. The buoyancy of a wooden boat of this type shall be provided by watertight air-cases, the total volume of which shall be at least equal to one-tenth of the cubic capacity of the boat.

5. The buoyancy of a metal boat of this type shall not be less than that required for a wooden boat of the same cubic capacity, and the volume of watertight air-cases shall be increased accordingly.

Class 1. (b). Lifeboats with Internal and External Buoyancy Appliances.

6. The internal buoyancy of a wooden boat of this type shall be provided by watertight air-cases, the total volume of which is at least equal to $7\frac{1}{2}$ per cent. of the cubic capacity of the boat.

7. The external buoyancy may be provided by means of cork or any other equally efficient material and shall not be less than $\frac{33}{1000}$ of the cubic capacity of the boat.

8. The buoyancy of a metal boat shall not be less than that required for a wooden boat of the same cubic capacity, and the volume of the watertight air-cases and of the external buoyancy shall be increased accordingly.

Lifeboats of Class 2.

Class 2 (a). Open Boats with Internal and External Buoyancy—Upper Part of Sides Collapsible.

9. A wooden boat of this type shall be fitted both with watertight air-cases and with external buoyancy appliances, the aggregate volume of which for each person which the boat is able to accommodate shall be at least equal to the following amounts:

Air-cases .. .. 1·5 cubic feet.
External buoyancy appliances (if of cork) 0·2 cubic feet.

10. A metal boat of this type shall be provided with internal and external buoyancy appliances to ensure that the buoyancy of the boat shall be at least equal to that of a wooden boat of the same cubic capacity.

11. The freeboard of a boat of this type shall be measured vertically to the top of the solid hull at the side amidships, from the water level, when the boat is loaded with its full complement of persons and equipment.

12. The minimum freeboard in fresh water of a boat of this type

shall be fixed in relation to its length and shall be determined by the following table:—

Length of boat in feet.	Minimum freeboard in ins.
26	8
28	9
30	10

13. The collapsible sides of every lifeboat shall be watertight.

Class 2. (b). Decked Boats with either Fixed or Collapsible Watertight Bulwarks.

14. In the case of boats of the type having a well deck the area of the well deck shall be at least 30 per cent. of the total deck area.

15. The minimum freeboard in fresh water shall be determined by the following table, which is applicable without correction to boats having a mean sheer equal to 3 per cent. of their length.

Depth of boat in inches.	Minimum freeboard in inches.
12	$2\frac{3}{4}$
18	$3\frac{3}{4}$
24	$5\frac{1}{8}$
30	$6\frac{1}{2}$

Class 3.

Open boats constructed in accordance with the provisions of these rules relating to lifeboats of Class 1, but not fitted with the internal or external buoyancy appliances of lifeboats of that class.

Lifeboats must be carried to accommodate the number of persons the ship is certified to carry.

When the number of lifeboats is more than 10, one of them shall be fitted with an approved wireless telegraphy installation.

Where the number of lifeboats is more than 15, one shall be a motor boat, and where the number is more than 20 two of them shall be motor boats. All such motor boats to be fitted with wireless and searchlights.

To Find Capacity of a Boat and Number of People it will carry.

The following rule is nearly correct:—

RULE.—Measure the length and breadth outside and the depth inside, multiply them all together and by ·6; the product is the capacity of the boat in cubic feet. Then divide by 10, the result is the number of persons the boat will carry. The bottom of the rowlocks is to be considered the gunwale of the boat for measuring her depth. Divide by 9 in boats of Class 1B.

WORKED EXAMPLE.—A lifeboat 28 feet long, 8·5 feet broad, and 3·5 feet deep. Required the capacity and the number of persons she will carry.

28
×8·5
14·0
224
238·0
× 3·5
1190
714
833·0
× ·6
499·8 cubic feet
10)499·8
49·98 *i.e.* 50 persons.

EXAMPLE.

A lifeboat 26 ft. long, 8 ft. broad and 3·25 ft. deep. Required the cubic capacity and number of persons it will carry.

Ans. 405·6 cubic feet.
40 persons.

Number of Davits and Lifeboats' Capacity.

Registered Length of the Ship.	(A) Minimum Number of Sets of Davits.	(B) Smaller Number of Sets of Davits Authorised exceptionally.	(C) Minimum Capacity of Lifeboats.	(D) Minimum Capacity of Lifeboats.
Feet.			Cubic Feet.	Cubic Feet.
100 and under 120	2	2	980	400
120 ,, 140	2	2	1,220	600
140 ,, 160	2	2	1,550	850
160 ,, 175	3	3	1,880	1,150
175 ,, 190	3	3	2,390	1,300
190 ,, 205	4	4	2,740	1,450
205 ,, 220	4	4	3,330	1,600
220 ,, 230	5	4	3,900	1,700
230 ,, 245	5	4	4,560	1,850
245 ,, 255	6	5	5,100	2,100
255 ,, 270	6	5	5,640	2,400
270 ,, 285	7	5	6,190	2,700
285 ,, 300	7	5	6,930	3,000
300 ,, 315	8	6	7,550	3,300
315 ,, 330	8	6	8,290	3,700
330 ,, 350	9	7	9,000	4,100
350 ,, 370	9	7	9,630	4,400
370 ,, 390	10	7	10,650	4,700
390 ,, 410	10	7	11,700	5,100
410 ,, 435	12	9	13,060	5,500
435 ,, 460	12	9	14,430	6,000
460 ,, 490	14	10	15,920	6,550
490 ,, 520	14	10	17,310	7,100
520 ,, 550	16	12	18,720	7,650
550 ,, 580	16	12	20,350	
580 ,, 610	18	13	21,900	
610 ,, 640	18	13	23,700	
640 ,, 670	20	14	25,350	
670 ,, 700	20	14	27,050	
700 ,, 730	22	15	28,560	
730 ,, 760	22	15	30,180	
760 ,, 790	24	17	32,100	
790 ,, 820	24	17	34,350	
820 ,, 855	26	18	36,450	
855 ,, 890	26	18	38,750	
890 ,, 925	28	19	41,000	
925 ,, 960	28	19	43,880	
960 ,, 995	30	20	46,350	
995 ,, 1,030	30	20	48,750	

Note on Columns (A) and (B).—When the length of the ship is 1030 feet or upwards the Board of Trade shall determine the minimum number of sets of davits for that ship.

Note on Columns (C) and (D).—For the purposes of this table the capacity in cubic feet of a lifeboat of Class 2 shall be obtained by multiplying the number of persons which the lifeboat is deemed to carry by 10.

Note on Column (D).—When the length of a ship is under 100 feet or is 550 feet or upwards, the minimum cubic capacity of the lifeboats shall be determined by the Board of Trade.

Boat Drill.

Emigrant Ships and other Foreign-going Passenger Ships.—Musters of the crew shall be held once a week either in port or at sea.

Home Trade Passenger Ships.—Shall muster their crew at boat stations at least once a month.

Cargo Ships.—Shall muster their crews at boat stations at least once a fortnight.

The dates upon which musters are held shall be recorded in the official log.

Penalty for failing to comply with any requirement of this section, a fine not exceeding £10.

Lifebuoys.

Lifebuoys may be constructed of cork or other suitable material to comply with Board of Trade Regulations. Lifebuoys of circular form are to comply with the following specification:—

The inside diameter to be 18 inches and the outside diameter 30 inches.

Major axis of cork section 6 inches.

Minor axis of cork section 4 inches.

Good quality cork, securely plugged together, covered with a suitable material, well coated with paint.

Grab lines to be fitted by sewing or seizing and in addition by bands of a double thickness of the covering material 3 inches wide at four equidistant points, providing four loops at least 2 feet 4 inches long.

Capable of floating in fresh water for 24 hours with 32 lbs. of iron suspended from it. Not to exceed 13½ lbs. in weight, when new.

The rules require at least one lifebuoy on each side of the ship to be fitted with a lifeline 15 fathoms in length; these lifelines are not to be fitted to the lifebuoys which are arranged for instantaneous release.

Every sea-going vessel with a bridge must carry a lifebuoy on or adjoining each side of the navigating bridge in such a manner that they can be released instantaneously so as to drop clear of the ship's side (by some method other than lifting the lifebuoy and throwing it overboard). Each of these lifebuoys must have a self-igniting lifebuoy light; these lifebuoy lights must open automatically by the release of the lifebuoy, be self-igniting in water and be capable of burning brightly for at least 40 minutes.

Cargo vessels, not certified to carry passengers, must carry at least six approved lifebuoys, together with one approved lifejacket for each person on board.

Passenger vessels shall carry lifebuoys in accordance with the following table:—

Length of ship.	Minimum number of lifebuoys.
Under 200 feet	8
Not under 200 feet but under 400 feet	12
Not under 400 feet but under 600 feet	18
Not under 600 feet but under 800 feet	24
800 feet and over	30

Every ship of this class shall carry one approved lifejacket for each person on board.

Lifejackets.

The required buoyancy may be supplied by cork, kapok, or other approved substance, but no lifejackets which depend on air compartments for their buoyancy will be accepted.

Cork lifejackets must be capable of supporting 16½ lbs. of iron in fresh water for 24 hours.

Kapok lifejackets must be capable of supporting at least 20 lbs. of iron after floating in fresh water for 24 hours with 16½ lbs. of iron attached.

To Adjust a Lifejacket.

Place the jacket over the head and pass the arms through the armholes. The jacket will slip over the head more easily if the hollow shape of the back pocket is first placed against the neck and the jacket is then drawn down over the head. Tie or half knot with the tapes in front, draw them well tight, then complete the knot.

Side Ladders.

Side ladders should be provided for each set of davits and should be of sufficient length to reach the waterline with the ship at her lightest draft and listed 15 degrees either way.

The ladder should be at least 18 inches wide with steps of hard wood having a tread at least 4 inches wide and not less than ¾ inch thick for ladders up to 30 feet in length, and 1 inch thick for ladders exceeding 30 feet in length.

The steps should not be more than 12 inches apart and they must be secured in such a manner as to prevent them tripping.

ROPES. BLOCKS, TACKLES, ETC.

ROPE.

The great proportion of rope in use at sea is manilla, although large springs of coir are very much used for stern moorings in open ports such as are common in the Mediterranean and elsewhere.

Rope is made from the fibres of certain plants twisted into yarns and again into strands, and then laid up into rope. The machine used for this purpose is called at sea a "spinning jenny;" ashore it is termed a "rope jack."

All rope, no matter from what material it may be made, is measured by its circumference.

Rope is usually 3-stranded with right hand lay. Hawsers may be cable laid; that is, three 3-stranded ropes laid up together left handed.

Wire rope is invariably 6-stranded, right hand lay, and is displacing hemp rope for most purposes at sea.

Marline is 2 yarn tarred hemp left hand laid.

Hambroline is 3 yarn tarred hemp right hand laid.

Houseline is 3 yarn tarred hemp left hand laid.

Spunyarn is from 2 to 8 yarns tarred hemp of inferior quality.

Point line is usually 21 thread manilla rope.

Ratline is 18, 21 or 24 thread tarred hemp and is used for ratlines and heaving lines.

Bolt rope is soft laid tarred hemp for sail ropes.

To find the breaking, proof and working strains of hemp rope up to 6 inches in circumference:

Square the circumference and divide by 3, 4 and 6. Thus a 4-inch rope—

$$\frac{4^2}{3}=\frac{16}{3}=5\tfrac{1}{3}\text{ tons—breaking strain.}$$

$$\frac{4^2}{4}=\frac{16}{4}=4\text{ tons—proof strain.}$$

$$\frac{4^2}{6}=\frac{16}{6}=2\tfrac{2}{3}\text{ tons—working strain.}$$

To find the breaking strain of flexible steel wire rope having 12 wires in each strand, square the circumference and multiply by 2.

To find it for extra flexible steel wire rope having 24 wires in each strand, square the circumference and multiply by 3.

Allow about one-fifth of the breaking strain for the safe working strain.

To find the size of hemp rope required to lift a weight of 10 tons by means of a 3-fold purchase having the hauling part at the upper block.

Increase the weight by $\frac{1}{10}$ for every sheave in the purchase, and divide by the number of parts of rope at the moving block. This gives the strain on the hauling part. The required circumference is found by taking the square root of the strain multiplied by 6.

Example.—$10+\frac{6}{10}$ of $\frac{10}{1}=16$. Divide by $6=2\frac{2}{3}$ tons strain.

$$\therefore\ c=\sqrt{\frac{16}{6}\times\frac{6}{1}}=\sqrt{16}=4\text{-inch rope.}$$

For wire rope. $\text{Strain}=\dfrac{c^2\times3}{5}$

$$\therefore\ \frac{c^2\times3}{5}=2{\cdot}66\text{ tons.}$$

$$\therefore\ c^2=\frac{2{\cdot}66\times5}{3}=\frac{13{\cdot}30}{3}=4{\cdot}43$$

$$\therefore\ c=\sqrt{4{\cdot}43}=2{\cdot}1\text{ inch.}$$

Chain is measured by the diameter of the iron forming the link.

The safe working strain of chain is obtained by squaring the diameter of the chain in eighths of an inch and dividing by 10.

Thus a 2-inch chain contains 16 eighths.

$$\therefore\ 16^2=256\div\text{by }10=25{\cdot}6\text{ tons.}$$

The breaking strain is found by squaring the diameter of the chain in 16ths and dividing by 10.

To find the number of parts of smaller rope to be equal in strength to one part of a larger rope, divide the breaking strength of the larger rope by the breaking strength of the smaller rope.

Example.—How many parts of a 2-inch rope are equal in strength to one part of a 4-inch rope?

$$\text{Breaking strain of 4-inch rope}=\frac{4^2}{3}=\frac{16}{3}$$

$$\text{Breaking strain of 2-inch rope}=\frac{2^2}{3}=\frac{4}{3}$$

$$\frac{16}{3}\div\frac{4}{3}=\frac{16}{3}\times\frac{3}{4}=\frac{16}{4}=4$$

Therefore 4 parts of 2-inch rope equal 1 part of 4-inch rope.

To find what size manila rope is equal in strength to flexible steel wire rope, divide the breaking strength of wire by the breaking strength of rope.

Example.—What size manila rope is equal in strength to a 4-inch flexible wire rope?

Let W=circumference of wire rope.

Let R=circumference of manila rope.

$$\text{then } W^2\times3=\frac{R^2}{3}$$

$$\therefore\ W^2\times3\times3=R^2$$

$$\therefore\ 4^2\times3\times3=R^2$$

$$16\times9=R^2$$

$$144=R^2$$

$$12=R$$

∴ a 12-inch manilla rope is equal in strength to a 4-inch flexible steel wire rope.

A rough rule is to reckon a manilla rope three times the size of a flexible steel wire rope as its equal in strength.

Flexible Steel Wire Ropes (Galvanised).

Flexible Steel Wire Rope. 6 Strands, each 12 Wires.				Extra Flexible Steel Wire Rope 6 Strands, each 24 Wires.		Special Extra Flexible Steel Wire Rope. 6 Strands, each 37 Wires.		Special Make.	
Size Circumference.	Weight per Fathom Approx.	Breaking Stress.	Diameter of Barrel or Sheave round which it may be worked at slow speed.	Weight per Fathom Approx.	Breaking Stress.	Weight per Fathom Approx.	Breaking Stress.	Breaking Stress.	Size Circumference.
Inches.	Lbs.	Tons.	Inches.	Lbs.	Tons.	Lbs.	Tons.	Tons.	Inches.
1	·63	1·75	6	·88	2·95	1·0	—	—	1
1¼	1·06	2·5	7½	1·31	4·45	1·56	—	—	1¼
1½	1·44	4·0	9	1·88	6·7	2·0	7·25	—	1½
1¾	2·0	5·5	10½	2·5	8·75	2·88	10·0	—	1¾
2	2·44	7·0	12	3·5	11·85	4·0	13·0	—	2
2¼	3·37	9·0	13½	4·5	14·6	4·88	15·75	—	2¼
2½	4·19	12·0	15	5·44	18·55	5·88	19·75	—	2½
2¾	5·25	15·0	16½	6·25	21·95	7·0	24·0	—	2¾
3	6·25	18·0	18	7·63	25·7	8·25	29·0	—	3
3¼	7·06	22·0	19½	9·37	30·8	10·38	33·5	—	3¼
3½	8·25	26·0	21	10·75	35·2	11·5	38·5	—	3½
3¾	9·87	29·0	22½	12·19	41·1	13·38	44·5	—	3¾
4	11·25	33·0	24	13·62	46·3	15·25	51·0	—	4
4¼	12·35	36·0	25½	15·69	52·9	17·12	58·0	—	4¼
4½	13·44	39·0	27	17·75	58·6	19·0	63·5	—	4½
4¾	—	—	—	19·88	66·4	21·69	71·25	—	4¾
5	—	—	—	22·5	74·2	24·38	79·25	—	5
5¼	—	—	—	23·25	82·88	27·69	87·75	—	5¼
5½	—	—	—	24·5	91·55	31·0	96·75	—	5½
5¾	—	—	—	—	—	33·75	103·75	—	5¾
6	—	—	—	—	—	36·5	113·75	—	6
6½	—	—	—	—	—	42·5	132·0	—	6½
7	—	—	—	—	—	48·5	154·0	—	7
7½	—	—	—	—	—	55·0	178·5	—	7½
8	—	—	—	—	—	63·0	198·0	202	8
9	—	—	—	—	—	79·0	250·0	257	9
10	—	—	—	—	—	98·0	305·0	318	10
11	—	—	—	—	—	120·0	—	381	11
12	—	—	—	—	—	142·0	—	455	12

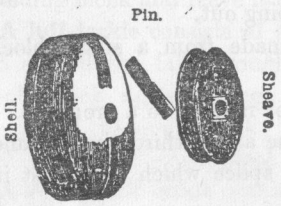
In these Flexible Wire Rope Tables, which have been prepared by Messrs. Bullivant & Co., Ltd. (who guarantee the above figures as regards new ropes supplied by them), the wire is calculated as taking a breaking stress of 90 tons to the square inch; ropes made of wire which is calculated above that will take a proportionately higher breaking stress.

BLOCKS.

Blocks are formed of wood or metal. Those used for guys and lifeboat tackles are usually made of wood; and for cargo are chiefly metal. They are measured by the length of the shell.

The parts of a block are: shell, score, sheave, pin, bush, swallow, strop, crown and tail or arse.

Fig. 6.



Parts of a Block.

Fig. 7.

Single Block.

Fig. 8.

Block Stropped.

Fig. 9.

Snatch-Block.

The shell—The case containing the sheave, and is usually made of elm.

The sheave—The wheel upon which the rope travels. If made of wood it is usually lignum vitae (a hard self-lubricating wood).

The bush—The metal centre of the sheave. This, in patent sheaves, contains metal rollers, and naturally works more easily than dummy sheaves.

The pin—Is made of steel, one end made larger to prevent it passing through the block altogether; the sheave revolves on it.

The swallow—Is the open part of the shell in which the sheave is placed.

The score—Is the groove in the shell to allow the strop to grip the shell tightly.

Note.—In blocks having metal strops, which may be either internal or external, no score is required.

The crown of the block—Is that part at the top where the hook of the strop is placed, and is known by the score not being so deep.

The tail—or arse—of the block—Is at the bottom and is known by the deep score.

There are many patent cargo blocks mostly self-lubricating; also open gin blocks are in common use for light cargo.

Snatch blocks are blocks with an opening in the shell to allow ropes to be placed without the necessity of reeving the end through, and have a hinged flap which can be clamped down by means of a forelock to prevent the rope jumping out.

Clump blocks are morticed, *i.e.* made from a single block of wood.

Strops for blocks are either spliced or made into a grommet.

If spliced, take the measurement one and a third times round the block and leave sufficient for the splice which must rest in the score in the tail of the block.

If making a grommet, measure three times round the block, the thimble and the rope itself.

TACKLES

A tackle is a purchase formed by reeving a rope called the fall through two or more blocks.

A whip or single whip consists of a rope rove through a single block. No power is gained, but ease in work is obtained.

A whip and runner purchase consists of a rope rove through one block and made fast to the crown of another block which also has another rope rove through it.

The power of a tackle is found by counting the number of parts of rope at the moving block.

A gun tackle consists of two single blocks, the fall rove through the blocks and the standing part made fast to the tail of the block containing the hauling part. Power gained two or three.

A single Spanish burton consists of two single blocks and a hook. Affix one end of the fall to the crown of a single block, reeve the other end through a single (standing) block. Overhaul sufficient length for the required purpose and attach a hook in the bight. Reeve the end through the first single block for the hauling part. Power gained three.

A double Spanish burton consists of two blocks, a whip and a fall. Reeve the whip through a single standing block and make the ends fast to the tail of one block and to the crown of the other. Make the standing part of the fall fast on the same level as the standing block and reeve it through both of the moving blocks.

A luff tackle consists of a double and a single block. Reeve the end of the fall through a double block, then through the single block, again through the double block and make fast to the tail of the single block. If double block is the moving block, power four. If single block is the moving block, power three.

A double luff tackle consists of two double blocks, the fall rove through them both and the standing and hauling parts of the fall are both at the same block. Power gained four or five according to which is the moving block.

A threefold purchase consists of two 3-fold blocks with the standing and hauling parts both at the same block. This may be rove straight forward or arranged to have both standing and hauling parts from the middle sheave holes, thus rove, the strain upon the purchase as a whole is more evenly distributed. Power gained six or seven whichever is the moving block.

It is not uncommon to see four and five fold purchases used for heavy cargo.

Blocks used for hemp or manilla rope should be three times the size of the rope, *i.e.* for a 3-inch rope use a 9-inch block.

Blocks in use with flexible steel wire should have sheaves the diameter of which should be not less than six times the size of the rope.

A tackle commonly used by engineers for lifting cylinder covers and other heavy machinery, or in dry docks for lifting

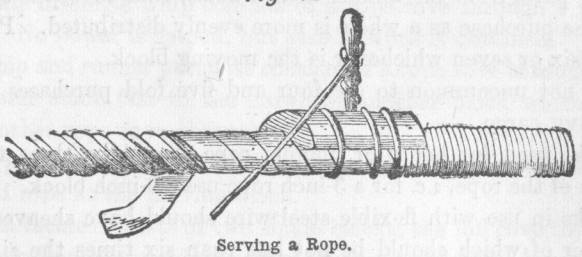
propellers and rudders, is "Weston's differential" blocks. It consists of two blocks, the upper block containing a double sheave in one casting, one sheave being of slightly smaller diameter than the other, and both revolving together. The lower block contains one sheave. All these sheaves are fitted with spaces so that the chain fall exactly fits into them, and thus prevents any possibility of it slipping. The chain fall is endless, and it is so rove that it passes first over the larger diameter sheave, then round the lower block sheave and again round the smaller sheave of the upper block.

It will be noticed that the movement of the lower block is very gradual as one complete revolution of the upper block only lifts the lower block very slightly. For instance, suppose the upper block to contain 20 spaces in the large diameter sheaves and 19 spaces in the smaller; this means that in one revolution the chain comes up 20 links but goes down 19 links, and the lower block rises the space of half a link.

A great advantage gained by using differential blocks is that a weight is suspended by it and does not work back, but would have to be over-hauled to lower the weight.

Always put a mousing on hooks or shackles of tackles to prevent vibration disconnecting them.

Fig. 10.



Serving a Rope.

Serving a Rope.

First worm the rope (that is, to fill in between the strands),

Hitches, Bends, Etc.

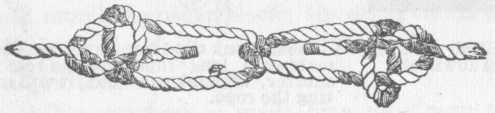
Fig. 11.

A Bowline.

Fig. 12.

A Running Bowline

Fig. 13.



Two Bowlines used for bending Two Lines or Hawsers.

Fig. 14.

Carrick Bend is also used for bending Two Hawsers together.

Fig. 15.

A Catspaw.

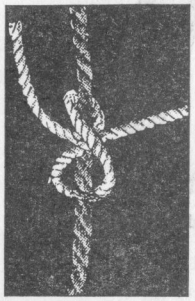
Fig. 16.

A Blackwall Hitch.

then parcel, last of all serve; worm and parcel with the lay of the rope, serve against the lay. The man keeps the serving mallet going round (see fig. 10), the boy passes round the ball of spun-yarn.

Hitches, Etc.

Fig. 17.



A Clove Hitch used for rattling down, etc.

Fig. 18.

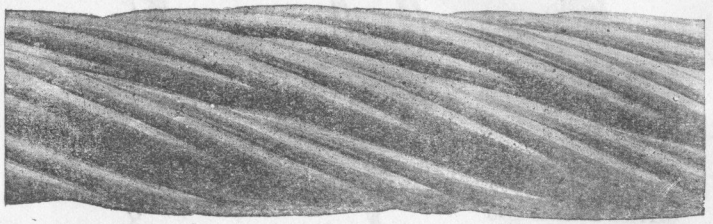
Sheepshank used for making a long rope shorter, without cutting the rope.

Fig. 19.

A Reef Knot, used for making reef points fast, etc., it will not jamb.

The flexibility of wire rope depends on the fineness and on the number of wires used to make the rope; also, in a small degree, on the strands of the rope having hempen hearts. The strength of the wire depends on the nature of the steel employed. Rigging wire, as a rule, has only one hempen heart, and is stronger than flexible wire.

Fig. 20.



Wire Rope.

Wire rope is used to a considerable extent on board ship; sail-makers parcel and serve it over, and marl it on to the sails instead of the ordinary bolt rope.

Wire rope has six strands, and there are various ways of splicing. To make an eye-splice, unlay the rope to the required length, then stop with twine; take the middle strand and pass it through the heart of the rope, then pass each strand left-handed; after all the strands have been passed, hammer them gently into position, and then tuck the ends through left-handed, as often as you may think necessary. In the second tucking you may take the hempen heart out of each strand, afterwards parcelling and serving neatly over all.

QUESTIONS AND ANSWERS.

How would you rig a single Spanish burton?

Have two single blocks, with a hook in the bight of the fall. One end of the fall is rove through the top block, and then spliced round the other block; the other end is rove through the lower single block. *See* fig. 23.

What is a gun tackle purchase?

A gun tackle purchase is made by a rope rove through two single blocks, and the end made fast to the fixed block.

What is a luff tackle purchase?

A luff tackle purchase is made by a rope rove through a single and double block, the end is made fast to the single block, and the fall leads from the double block. *See* fig. 22.

What is a runner?

A line rove through a single block with an eye-splice in one end.

Luff tackle purchase and runner is used for setting up the lower rigging.

What is luff upon luff?

A luff tackle made fast to the fall of another luff tackle.

What is a watch tackle?

A handy luff tackle, with a hook on the single block, and a short tail about 6 feet on the double block.

What is a handy billy?

A handy little tackle; the fall is rove through a small single and double block.

How do you rig relieving tackles?

With four double or single blocks, and a single block amidships. When rove, it is an endless fall, and allows the tiller to go hard over both ways.

When do you use relieving tackles?

In bad weather when the ship is pitching about, have the tackles placed on the quadrant and hove taut.

What is a lizard?

A piece of wood with a hole in its centre, and a groove round it for splicing in a tail.

What is a dead-eye?

A round piece of wood with three holes in it for lanyards; also a groove round it to take a shroud.

How would you rig a Spanish windlass?

With a heaver and a strong round piece of wood, such as a capstan bar; to use it—place the lanyard or rope round the bar, and set up with the heaver.

How would you make fast a stopper?

Get a suitable piece of rope about 3 feet long, make a Matthew Walker knot on each end, and seize it on the broken rope.

What is a Matthew Walker knot used for?

The lanyards of the rigging; it is the principal knot used on board ship for lanyard rigging.

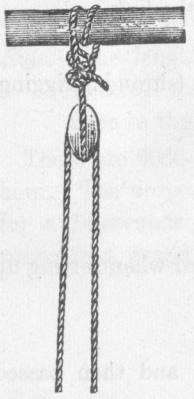
What is a reef knot?

It is the knot used when reefing; the ends come out together through the bights, and it will not jam.

How do you measure a block?

Take the length of the outside shell.

Fig. 21.

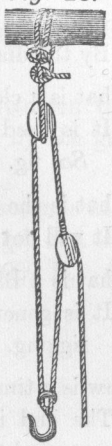


Single Whip.

Fig. 22.

Luff or Watch Tackle.

Fig. 23.

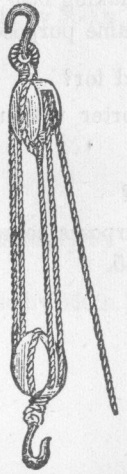


Sing'e Spanish Burton.

Fig. 23a.

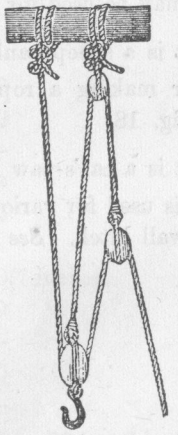
Gun Tackle.

Fig. 23b.



Double Luff Tackle.

Fig. 24.



Double Spanish Burton.

How do you measure a rope?

By the circumference.

How do you measure chain or cables?

By the diameter of the bar of iron forming the link.

What is a clove hitch used for?

It is used for hitching the ratlines to the (shrouds) rigging. *See* fig. 17.

What is the advantage of a figure-eight knot?

It will not jam.

What is a Blackwall hitch used for?

It is generally used on the end of a lanyard when setting up rigging. *See* fig. 16.

How is a timber hitch made?

The end is taken round the hauling part, and then passed several times round its own part.

What is a carrick bend?

It is a useful bend for making fast two hawsers; two bowlines may be used for the same purpose. *See* fig. 14.

What is a sheepshank used for?

For making a rope shorter without having to cut it. *See* fig. 18.

What is a cat's-paw hitch?

It is used for various purposes, sometimes in place of a blackwall hitch. *See* fig. 15.

LOG AND LEAD LINES.

Hand Log Line and Sand Glass.

The log line (with sand glass) is used for finding the rate at which a vessel is sailing through the water.

Rule.—The length of a knot bears the same proportion to a nautical mile as the number of seconds run by the glass does to the number of seconds in an hour.

There are 6080 feet in a nautical mile, and 3600 seconds in an hour. The proportion, therefore, for finding the length of a knot for a 14-seconds glass would be 3600s. : 14s. :: 6080 ft. Our proportion would thus become—

Sec.		Sec.		Feet.
3600	:	14	::	6080

Multiply by 14s.

24320
6080

Divide by 3600s.)85120(23 feet.
7200

13120
10800

2320

Multiply by 12

Divide by 3600s.)27840(7 inches.
25200

2640

Answer—23 feet 7 inches.

What is the short rule for measuring the log line?

To the number of seconds run by the glass annex a cipher, and divide by 6; the answer is the feet, and the remainder (if any) multiplied by 2, will be inches.

Example for a 14 seconds glass:—

$$\begin{array}{r} \div 6)140 \\ \hline 23 \quad 2 \\ \times 2 \\ \hline = \quad 4 \text{ inches.} \end{array}$$

Answer—23 feet 4 inches.

This short method is not strictly correct, but it is generally used on board vessels, as it prevents the ship getting ahead of the dead reckoning.

To mark the log line have it well stretched and wet, measure off the amount of stray line, and then put a mark with a piece of white rag; next mark off the length of the knot and put a piece of leather, afterwards using a piece of hamberline for the other marks. The amount of stray line depends on the length of the vessel; generally about 15 fathoms.

In the event of the sand glass getting wet or broken, use a watch with a seconds hand.

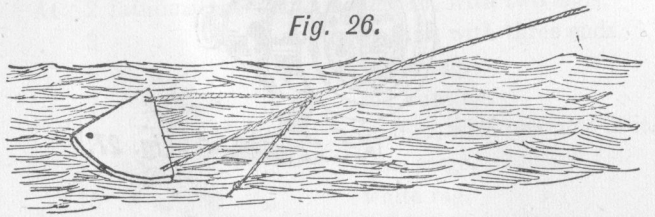
Fig. 25.

Log Ship—Heaving the Log.

To Heave the Log.—Three men are required. One man holds the log-reel, the other holds the glass; the officer places the peg in the socket, the man with the reel stands a little forward, the officer pulls a few fathoms of line from the reel and drops the log ship

over the stern on the lee side; the line now runs out; when the white rag comes to the rail, he quickly calls "turn." The man with the glass promptly turns the sand glass; the line is now running

Fig. 26.



Log Ship—Hauling in the Line.

off the reel as fast as the vessel is sailing. The moment the sand runs out of the glass the man calls "stop." The officer immediately stops the line, and so, by the mark which is near to his hand, he can find the rate the vessel is sailing. A sudden jerk to the line takes the peg out of log ship and line is hauled in. *See* fig. 26.

To Read the Log Line.

Marks of the Line.		Knots Vessel Sails.
Piece of leather,	=	1 knot.
Leather with two legs,	=	2 knots.
Leather with three legs,	=	3 ,,
Two knots,	=	4 ,,
One knot,	=	5 ,,
Three knots,	=	6
One knot,	=	7 ,,
Four knots,	=	8
One knot,	=	9
Five knots,	=	10 ,,
One knot,	=	11 ,,
Six knots,	=	12 ,,
One knot,	=	13 ,,
Seven knots,	=	14 ,,
One knot,	=	15 ,,
Eight knots,	=	16 ,,

The Patent Log.

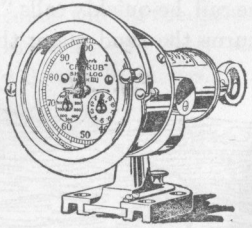


Fig. 27.

The Hand Lead Line.

The hand lead is generally 7 pounds weight, and is used in rivers and shallow waters where soundings are required to be taken frequently without stopping the vessel. In sailing vessels the

Fig. 28.

The Hand Lead.

leadsman stands on the weather side, and in steamers at or near the bridge, where he is under the watchful eye of the pilot and the officer on watch.

To throw the lead requires considerable practice: the man swings the lead backwards and forwards a few times, and when on

the forward swing lets go; he then quickly takes in the slack line and calls out the soundings, or no bottom, as the case may be.

The lead line has 9 marks and 11 deeps.

At	2	fathoms the mark is	leather, with two ends.
	3	„	leather, with three ends.
	5	„	white rag.
	7	„	red bunting.
	10	„	leather, with one hole in it.
	13	„	blue serge.
	15	„	white rag.
	17	„	red bunting.
	20	„	piece of cord with two knots.

To Report Soundings.

At	5	fathoms the leadsman calls out—		by the mark 5.
	$4\frac{3}{4}$	„	„	$\frac{1}{4}$ less 5.
	$4\frac{1}{2}$	„	„	and a $\frac{1}{2}$ 4.
	$4\frac{1}{4}$	„	„	and a $\frac{1}{4}$ 4.
	4	„	„	by the deep 4.
	5	„	„	by the mark 5.
	6	„	„	by the deep 6.
	$6\frac{1}{4}$	„	„	and a $\frac{1}{4}$ 6.
	$6\frac{1}{2}$	„	„	and a $\frac{1}{2}$ 6.
	$6\frac{3}{4}$	„	„	$\frac{1}{4}$ less 7.
	7	„	„	by the mark 7, etc.

Deep-Sea Lead.

The deep sea lead line is marked in the same way up to 20 fathoms, and then a cord with 3 knots indicates 30 fathoms, an additional knot for every 10 fathoms, and at every 5 fathoms a piece of cord with a single knot.

When using the deep-sea lead, it should always be armed with tallow in the hollow at the foot, so that on examination the nature of the ground may be compared with the instructions given on the chart. The length of the line is generally from 90 to 120 fathoms, and the weight of the lead 28 lbs.

SAILING SHIPS.

Three-masted Ship

A full rigged ship has three masts, and yards on all the masts. The masts are named—Foremast, mainmast and mizen mast.

Four-masted Ship.

The masts are named—Foremast, mainmast, mizen mast, and jigger mast.

Five-masted Ship.

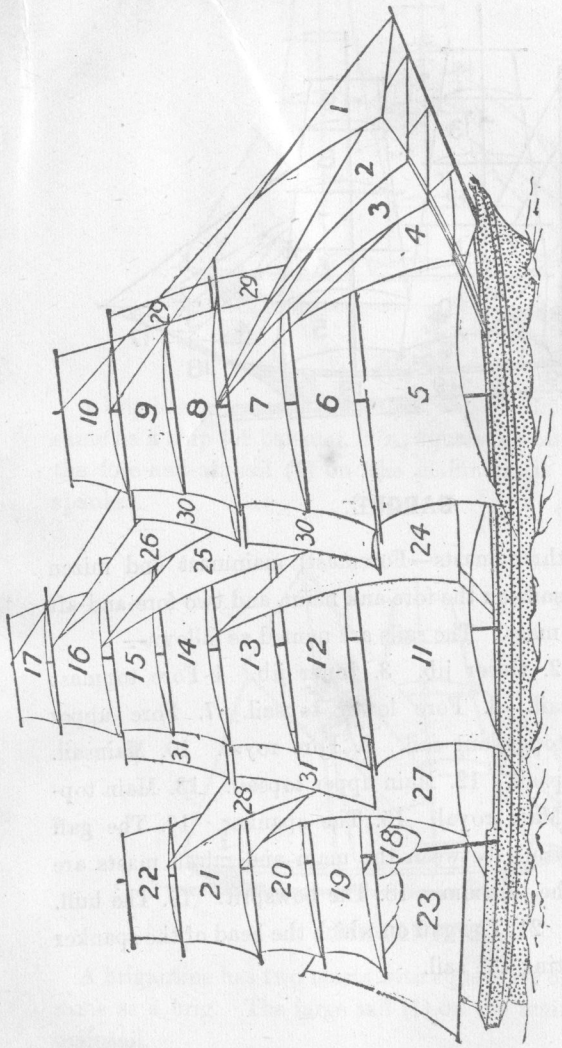
The masts are named—Foremast, mainmast, mizen mast, jigger mast, and the fifth mast is called a pusher. The sails on the pusher mast are spanker and gaff topsail.

Bark or Barque.

A bark has three masts—Fore, main, and mizen, with square sails on the fore and main masts. Spanker and gaff topsail on the mizen mast.

Brig.

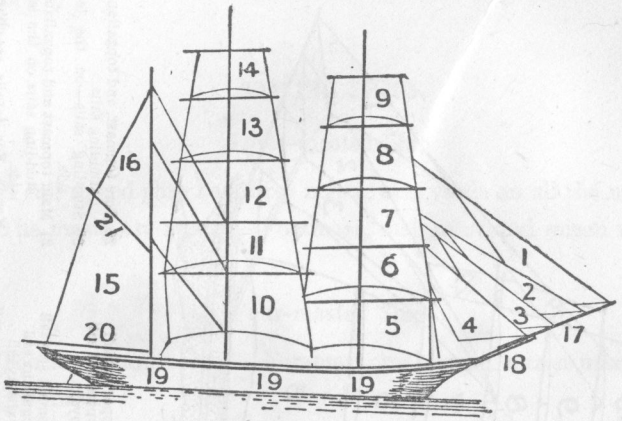
A brig has two masts—Square rig same as full-rigged ship.



SAILS OF A SHIP.

1 Flying jib
2 Outer jib
3 Inner jib
4 Fore topmast staysail
5 Fore sail (or fore course)
6 Lower fore topsail
7 Upper fore topsail
8 Fore lower topgallant sail
9 Fore upper topgallant sail
10 Fore royal
11 Main sail (or main course)
12 Lower main topsail
13 Upper main topsail
14 Main lower topgallant sail
15 Main upper topgallant sail
16 Main royal
17 Main skysail
18 Cross jack (hauled up)
19 Mizen lower topsail
20 Mizen upper topsail
21 Mizen topgallant sail
22 Mizen royal
23 Spanker
24 Main topmast staysail
25 Main topgallant sail
26 Main royal staysail
27 Mizen topmast staysail
28 Mizen topgallant staysail
29 Fore topmast, and topgallant studding sails
30 Studding sails—on the lee side.
31 Main topmast and topgallant studding sails on the lee side.

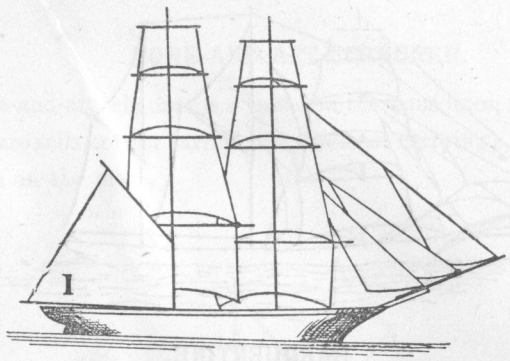
NOTE.—For details, *see* chapter on Sailmaking.



BARQUE.

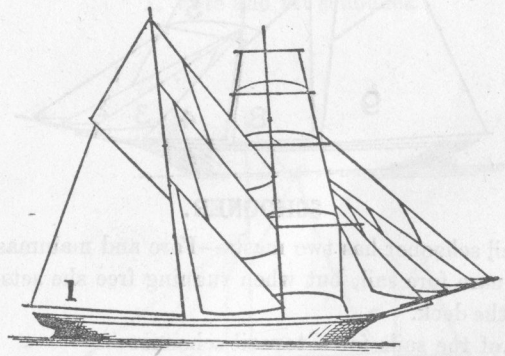
A barque has three masts—Foremast, mainmast and mizen mast, with square sails on the fore and main, and two fore-and-aft sails on the mizen mast. The sails are named as follows—

1. Flying jib. 2. Outer jib. 3. Inner jib. 4 Fore topmast staysail. 5 Foresail. 6. Fore lower topsail. 7. Fore upper topsail. 8. Fore topgallant sail. 9. Fore royal. 10. Mainsail. 11. Main lower topsail. 12. Main upper topsail. 13. Main topgallant sail. 14. Main royal. 15. The spanker. 16. The gaff topsail. The staysails between the main and mizen masts are not shown. 17. The jibboom. 18. The bowsprit. 19. The hull. 20. Spanker boom. 21. The gaff on which the head of the spanker runs out when setting the sail.



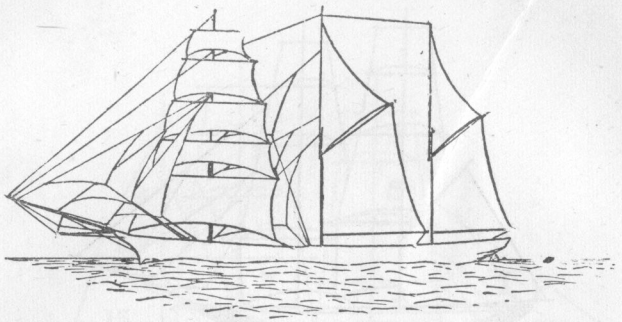
BRIG.

A brig has two masts—Foremast and mainmast. The rig is the same as a ship (or barque), viz., square rig on the fore and main; the fore-and-aft sail (1) on the mainmast is called a trysail or spanker.



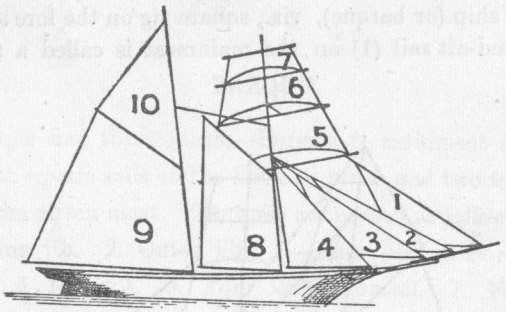
BRIGANTINE.

A brigantine has two masts with square rig on the foremast, the same as a brig. The large sail (1) on the mainmast is called the mainsail.



BARQUENTINE.

A barquentine has three masts—Square rig on the foremast, and fore-and-aft on the main and mizen masts.



SCHOONER.

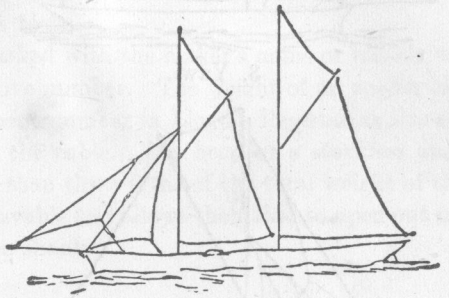
A topsail schooner has two masts—Fore and mainmasts. She has no square fore sail, but when running free she sets a square sail from the deck.

Names of the sails for a topsail schooner—

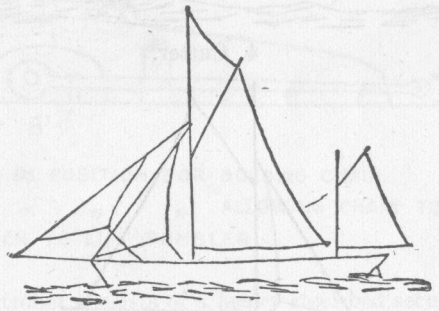
1. Flying jib
2. Outer jib.
3. Inner jib.
4. Fore staysail.
5. Topsail.
6. Topgallant sail.
7. Royal.
8. Boom foresail.
9. Mainsail.
10. Gaff topsail.

FORE-AND-AFT SCHOONER.

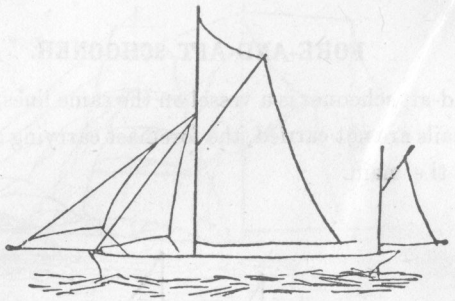
A fore-and-aft schooner is a vessel on the same lines, except that the square sails are not carried, the foremast carrying a gaff topsail same as on the main.



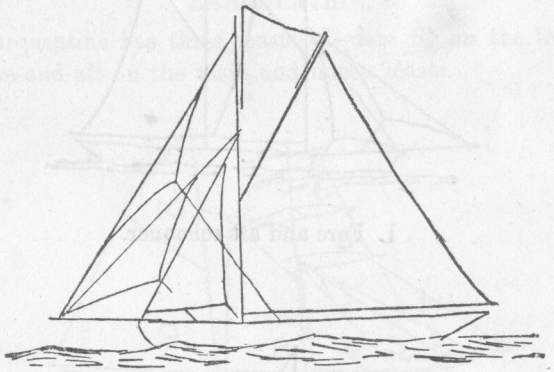
1. Fore and aft schooner.



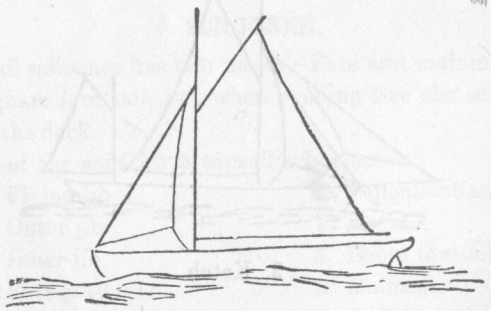
2. Ketch.



3. Yawl.



4. Cutter.



5. Sloop.

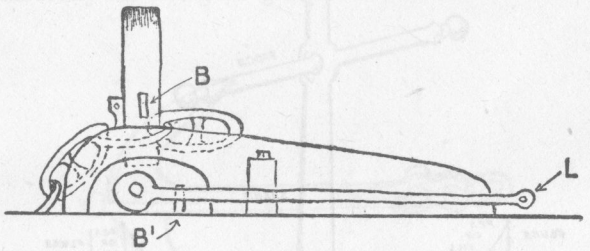
ANCHORS.

It is usual in steamers to have at least four anchors, *i.e.* two bowers, a spare bower and a stream. Also it is practically a universal custom to have stockless anchors for the bowers and the old-fashioned anchors with stocks for the stream.

They are made of forged wrought iron, forged open hearth ingot steel or cast steel, and are subjected to bending, hammering and percussive tests.

They are marked with the maker's name or initials, the weight and a progressive number. The weight of an anchor is governed by the equipment number in Lloyd's Register, as also are the size and length of the cable. The head of a stockless anchor must weigh not less than three-fifths of the total weight of the anchor. The head is movable and allows the flukes to open out to an angle of 45° with the shank.

CHAIN CONTROLLER



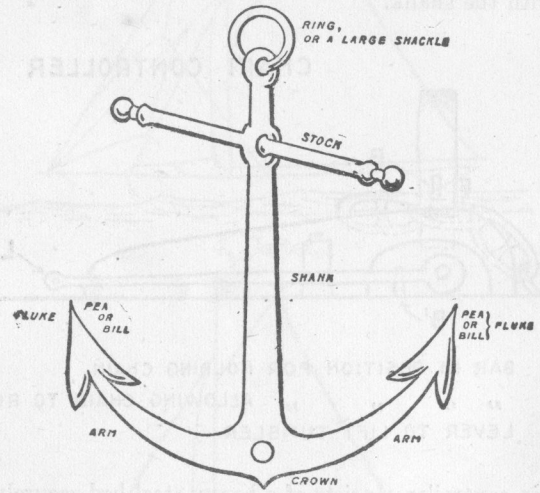
B BAR IN POSITION FOR HOLDING CHAIN
B' „ „ „ „ ALLOWING CHAIN TO RUN
L LEVER TO LIFT TUMBLER

A chain controller consists of a heavy steel bed securely bolted to the deck. Along the length on top is a groove for the chain to travel along. At the after end is a recess into which is fitted a block free to move up and down in leads, this block being con-

trolled by a long lever. A guard hoop is fitted securely to the block, and in which is an oblong hole through which a heavy bar is placed over a horizontal link of the cable keeping it in the recess and thus allowing all the weight to be taken from the windlass. The weight is taken by the lever, and the bar or pin taken out of the lower position and the block allowed to drop, and then the bar is shipped above the chain when it is required to hold the chain. When the tumbler is held up by the bar in the lower position the chain can run freely.

A length of cable is 15 fathoms, and the vessel's full cable 120 fathoms; the lower end of the cable is made fast to the foremast, or *to the keelson.* When the cable is stowed in the chain locker the upper end is passed up and over the windlass, then through

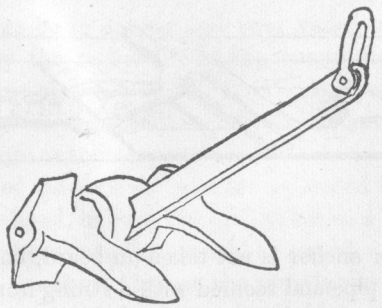
Fig. 29.



Bower Anchor.

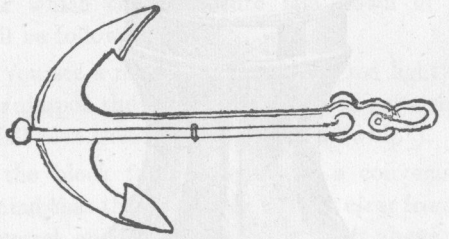
the hawse hole and shackled on to the anchor. The square end of the cable shackles always comes on board first. Some anchors

have no stock, the shank comes in through the hawse pipe, and the anchor fits close up to the vessel's bow; before making port



STOCKLESS ANCHOR

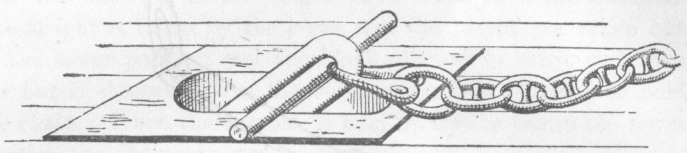
it is advisable to have these anchors hove out and hanging clear, and all ready for being let go. If this is not attended to you



STREAM ANCHOR
STOCK HOUSED FOR STOWING

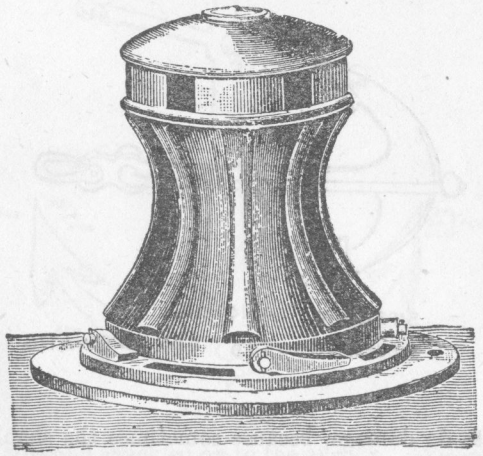
are liable to do damage, because sometimes the shank gets foul in the hawse pipe.

Fig. 30.



The stockless anchor is not taken on board, but hove right up into the hawse pipe and secured with a strong iron bar and chain lashings or by an iron clamp. *See* fig. 30.

Fig. 31.



Capstan.

INSTRUCTIONS ISSUED BY THE BOARD OF TRADE

For the Guidance of Masters and Seamen when using the Rocket Apparatus for Saving Life.

1. Should lives be in danger and your vessel be in a position where rescue by the rocket life-saving apparatus is possible, a rocket with a line attached will be fired across your vessel. Get hold of this line as soon as you can. When you have got hold of it, signal to the shore as follows:—

By day, one of the crew—if possible separated from the rest—should wave his hand, or handkerchief, or hat or a flag. By night a flare should be burnt or a light should be waved. If the visibility should be poor, one short blast on the whistle can be employed in place of the above signals by day or by night.

Alternately, should your vessel carry a line throwing appliance and this is first used to fire a line ashore, which line would not be of sufficient strength to haul out the whip, those on shore will secure it to a stouter line and when this is done will wave a red flag (at night—a red light). On seeing this signal, haul in on the line until the stouter line is on board. Then make signal as indicated above, after which the procedure laid down in paragraph 2 onwards will be followed.

2. When you see a red flag (at night—a red light) waved from the shore, haul upon the rocket line until you get a tail block with an endless fall rove through it (called the "whip").

3. Make the block fast, close up to a convenient position, bearing in mind that the fall should be kept clear from chafing any part of the vessel, and that space must be left above the block for the hawser (*see* para. 5). Unbend the rocket line from the whip. When the tail block is made fast and the rocket line unbent from the whip, signal to the shore again as in para. 1 above.

4. As soon as this signal is seen on shore a hawser will be bent to the whip and will be hauled off to the ship by those on shore.

Except when there are rocks, piles or other obstructions between the ship and the shore, a bowline will have been made with the end of the hawser round the hauling part of the whip.

5. When the hawser is got on board the bowline should be cast off. Then, having seen that the end of the hawser is clear of the whip, the end should be brought up between the two parts of the whip and made fast to the same part of the ship as the tail block, *but just above it and with the tally board close up to the position to which the end of the hawser is secured* (this will allow the breeches buoy to come right out and will facilitate entry to the buoy).

6. When the hawser has been made fast on board, unbend the whip from the hawser and see that the bight of the whip has not been hitched to any part of the vessel and that it runs free in the block. Then signal to the shore as in para. 1.

7. The men on shore will then set the hawser taut, and by means of the whip will haul off to the ship the breeches buoy into which the person to be hauled ashore is to get. He should sit well down in the breeches and when he is secure signal again to the shore as in para. 1 and the men on shore will haul the person in the breeches buoy to the shore. When he is landed the empty breeches buoy will be hauled back to the ship. This operation will be repeated until all persons are landed.

8. It may sometimes happen that the state of the weather and the condition of the ship will not admit of a hawser being set up; in such cases a breeches buoy will be hauled off by the whip which will be used without the hawser.

The system of signalling must be strictly adhered to. It should, however, be noted that while the signals referred to in para. 1 are made only when the crew have got hold of the rocket line; when the tail block has been made fast; when the hawser has been made fast; and when a person is in the breeches buoy ready to be hauled ashore, the rescue operations as a whole will, as a rule, be greatly facilitated if signal communication (by semaphore or flashing

Fig. 32.

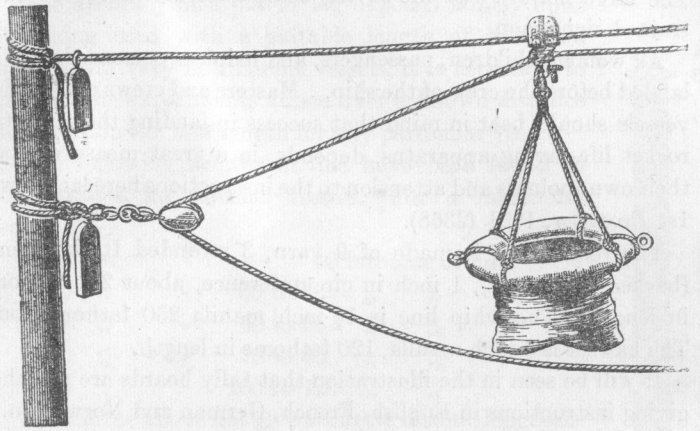
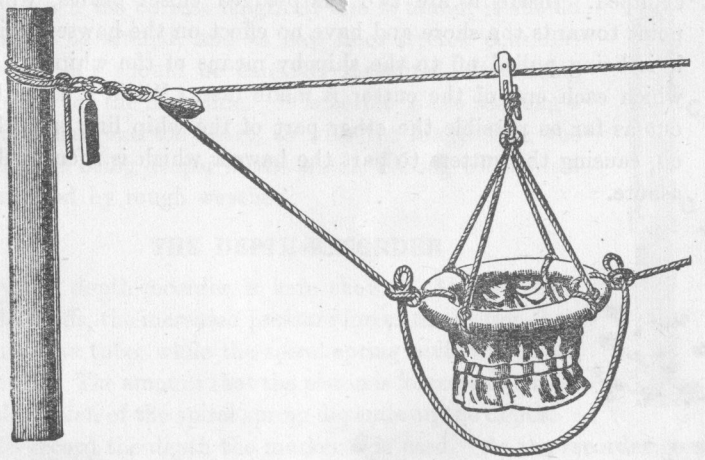


Fig. 33.



lamp) is established between the ship and the shore (or lifeboat). The large majority of life-saving companies and lifeboats have trained signalmen.

All women, children, passengers, and helpless persons should be landed before the crew of the ship. Masters and crews of stranded vessels should bear in mind that success in landing them, by the rocket life-saving apparatus, depends, in a great measure, upon their own coolness and attention to the instructions here laid down. 1*st December*, 1931 (2368).

The rocket line is made of 9 yarn, 3 stranded Italian hemp (barked or tanned), 1 inch in circumference, about 250 fathoms in length. The whip line is 1½-inch manila 250 fathoms long. The hawser is 3-inch manila, 120 fathoms in length.

It will be seen in the illustration that tally boards are attached giving instructions in English, French, German and Norwegian.

It may also be mentioned that when the hawser is no longer required, it may be released from the ship, for this purpose a hawser cutter is used. It resembles a long block, and it is hinged so that it may be opened and the hawser put in and then again clamped. Inside it are two sharp-edged chisel blades, which point towards the shore and have no effect on the hawser whilst it is being pulled off to the ship by means of the whip line to which each end of the cutter is made fast. When it is pulled out as far as possible the other part of the whip line is hauled on, causing the cutters to part the hawser which is then hauled ashore.

Length of Line for Patent Logs.

The accuracy of a patent log depends largely upon its being used with a suitable length of line, and as this will vary in different vessels, it is necessary to make some experiments at sea over a known distance to ascertain the best length for any particular vessel.

The following lengths of line have been found to be suitable for normal vessels. For a maximum speed of:—

10 knots	-	-	40 fathoms of line.
15 „	-	50 to 55	„ „
18 „	-	60 to 65	„ „
20 „	-	70 to 80	„ „
25 „	-	100 to 120	„ „

Should the above not give accurate results, lengthening the line will usually be found to increase the log registration and *vice versa*. For small high speed vessels, such as torpedo destroyers and motor boats, shorter lines can be used than those given above.

When the correct length of line is found, it should never be altered, and as new lines stretch considerably they should be carefully measured after being in use for the first time. It is better to use too long a line than one too short, as with the longer line, the rotator being deeper in the water, the log will be less affected by rough weather.

THE DEPTH-RECORDER

The depth-recorder is here shown. As the sinker descends, the increased pressure forces the piston *D* up into the tube, while the spiral spring pulls the piston back. The amount that the piston is forced up against the action of the spiral spring depends on the depth. To record the depth the marker *C* is used. As the recorder goes

down the marker is pushed along the piston. When the recorder is brought up to the surface of the water the piston comes back to its original position, but the marker remains at the place on the scale to which it was pushed, and shows the depth to which the recorder has been. The depth is read off by the cross wire of the marker.

Between each cast the nut *A* should be unscrewed to slacken the valve *B* and the recorder should be turned upside down to empty out any water which may have leaked in. A little water in the upper bottle will not interfere with the accuracy of the indications of the recorder. It may not be found necessary to empty the bottle every time. Make sure before each cast that the screw *A* is firmly screwed up and the marker set at zero.

Occasionally a little grease should be pushed up the piston into the tube to keep the leather packing of the piston in good order.

Instructions for Ordinary Use of the Machine.

1. The work of taking a cast is to be done by two men, under the superintendence of an officer. For brevity, the men will be referred to as brakesmen and leadsmen. The regular post of the brakesman is at the starboard side of the sounding machine. The regular post of the leadsman is beside the taffrail fair-lead.

2. **Take a Cast.**—The men go to their posts, and without further orders the brakesman puts on the two handles and fixes them securely by means of the screws. At the same time the leadsman sees that the lead is properly armed and takes it along to the fair-lead. The officer examines the depth-recorder to see that the marker is set to zero and replaces it in the sinker.

3. **Brake on.**—The brakesman standing on the starboard side of the machine sees that the arm is prevented from turning by means of the catch. He then takes hold of the handle and puts the brake on by turning the handle in.

Deep Sea Soundings. (*To Read the Recorder.*)

The officer reads the depth by the position of the cross wire of the marker *C* and resets the marker. He then unscrews the screw *A*, slackens the valve *B*, empties out any water that may have leaked in, and having tightened up the screw *A* the recorder is ready for a fresh cast.

Soundings with Chemical Tubes.

When the chemical tubes are used instead of the depth-recorder, one of the brass guard tubes is lashed to the rope between the wire and the sinker about 3 feet from the end of the wire. Before taking a cast the officer places a glass tube with the open end down in the guard tube and puts the cap on. When the guard tube is brought up close to the fair-lead pulley it should be lifted on board, care being taken to keep it right side up. If it is turned on its side or upside down, the water will run up the glass tube and produce a bad mark. The officer takes out the glass tube and applies it to the scale with the closed end against the brass plate at the top of the scale. He reads off the number of fathoms shown on it by the lowest part of the red coating. This without correction will be the depth accurately enough if the barometer be at anything from $28\frac{3}{4}$ to $29\frac{1}{2}$ inches.

Caution.—The wire will break at a kink under a very moderate pull. 30 lbs. steady force, or a very slight jerk, will break it at a kink. Without a kink, and with proper care, the wire can scarcely be broken in practice with the machine. No wire should ever be lost in service, unless by some extremely rare accident, not foreseen, and therefore not provided against.

Merchant Pattern Sounding Machine

This, on account of its low price, is the most popular form of sounding machine used by the Merchant Service. The frame is built up of malleable iron castings, so that it will stand the rough usage it is liable to encounter at times, without any fear of fracture

of castings, etc. It is extremely simple to use, and is provided with a depth dial for reading off the length of sounding wire run out immediately the sinker has touched bottom. This type of sounding machine is designed for taking soundings from aft, and no auxiliary boom is required. When ordering this type of machine it is necessary to specify "Lord Kelvin's Merchant Pattern," so that no confusion may arise with the Mark IV., or Admiralty Pattern. These machines are constructed on the fact that the pressure of water increases with the depth.

Boyle's Law states:—The volume of a given mass of gas is inversely proportional to the pressure when the temperature is kept constant.

A glass tube, uniform in bore and 24 inches in length, is coated on the inside with chromate of silver; when this tube is lowered to any depth the pressure forces the water into the tube compressing the air inside. The action of the salt water on the coating inside the tube changes it into chloride of silver. Should the scale be lost, one of the following methods may be used, to ascertain the depth:

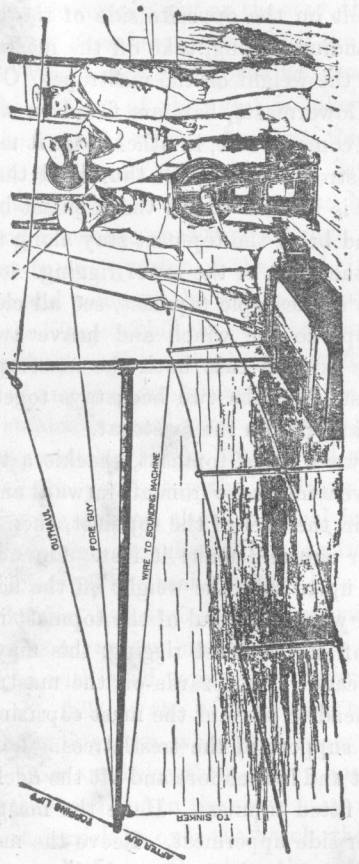
1. Divide the length of the discoloured part of the tube by the length of the plain part and multiply by 5·5. The result is the depth in fathoms.

2. Divide the length of the discoloured part of the tube by the length of the plain part, then multiply by ·1837 times the height of the barometer in inches.

Example.—The discoloured part of the tube on taking soundings measured 18 inches. Required the depth of the water without using the scale. Barometer 30 inches.

1st method $\frac{\overset{3}{\cancel{18}}}{\cancel{6}} \times 5{\cdot}5 = 16{\cdot}5$ fathoms.

2nd method $\frac{18}{6} \times {\cdot}1837 \times \frac{5}{\cancel{30}} = 16{\cdot}533$ fathoms



How to use the Sounding Machine.

MAST AND YARDS.

In sending down a telescópic topmast, marry the wire mastrope to the dummy gantline, haul through and make fast the mastrope to an eyebolt on the opposite side of the lower masthead. Come up the standing rigging, take off the mastcoat, unship the wedges and take the weight on the mastrope. Out fid and lower away. In some lowermasts, bars are fitted on which the heel of the topmast will come to rest; in other cases it may be necessary to belay the mastrope, which will thus hold the weight of the topmast while it is housed. Lash the topmast backstays to the lower shrouds and bring the topmast stay along to the mast and make it fast to the mast or the lower rigging.

In sending up a telescopic topmast, see all clear for running, take the mastrope to the winch and heave away; when high enough, ship the fid and ease back the mastrope. Set up the topmast stay first, then the two backstays together, wedge the mast if required and put on the mastcoat.

In sending down a fitted topmast, shackle a top block to the lower cap. Reeve a mastrope from aft forward and down through the sheave hole in the heel of the topmast, then up to the other side of the lower cap and make it fast. Come up all standing rigging. Heave up to take the weight off the fid and unship it. Lower away and when the head of the topmast is level with the lower cap take off the topmast rigging; this may be stopped to the lower masthead. Put lizards on the mastrope and attach to the topmast head to prevent the mast capsizing when lowered down below the support of the trestletrees. Lower away, land the heel on a mat and launch fore and aft the deck.

To send up a fitted topmast. Have the mast on deck, head forward and after side uppermost. Reeve the mastrope through a block at the lower cap, down through the trestletrees and also the collar of the stay (if necessary), reeve it through a lizard at the topmast head, through the sheave hole in the heel of the topmast, up through another lizard at the topmast head, again

between the trestletrees and make fast to the lower cap. Heave away on the mastrope, and when the topmast head is pointed through the trestletrees cast off the lizards. When the head is pointed through the lower cap, put on the stay, then the starboard and port backstays. Now heave away until the fid hole is above the trestletrees. Vast heaving, ship the fid, ease back the mastrope so that the weight of the mast is taken by the trestletrees. Set up the standing rigging stay first, then the backstays.

To send down a steamer's signal yard. Send a hand aloft with a tail block and yard rope. Make the block fast to the topmast head and reeve the yard rope through from aft forward and make it fast to the quarter of the yard. Take the weight on the yard rope and come up the clamp. Heave up a little and come up one of the lifts, cockbill the yard and put a stopper on to the yard and yardrope. Come up the other lift and lower down to the deck, steadying it down by means of the signal halyards.

To send up a steamer's signal yard. Reeve a yardrope through a block at the topmast head from aft forward and clove hitch it to the quarter of the yard; stop the yardrope to the yardarm. See that the lifts are on and also the signal halyards are rove. Heave up, and when high enough cast off the yardarm stopper and square the yard, clamp it and make fast the lifts to the masthead.

To rig derricks for discharging cargo overside, one being a stay derrick, one as a yardarm derrick.

Rig the derricks with good topping lifts, guys, gin blocks and runners. Take the falls of the topping lifts to the winch and heave up, hands tending guys, when high enough, stopper off the topping lift purchases and belay them. Guy one derrick over the hatch and the other well out to the side.

Should the port derrick be over the hatch, the port guy of this derrick must be made fast well out to the side of the ship, the other may be taken well forward to the starboard side clear of the runner. The starboard guy of the starboard derrick must be taken well aft to prevent the derrick swinging amidships, the

inner guy being led forward clear of the runner. Shackle the runners together so that when the weight is hove high enough the yardarm derrick may take the weight, and as you come back on the stay derrick will swing out overside.

STEERING GEARS.

A common form of steering gear is to have a steam steering engine, usually situated on the after part of the top platform in the engine room. The engine is controlled from the bridge by the steering wheel in the wheelhouse which, when turned, revolves a stout brass rod fitted with mitre wheels at every turn.

The purpose of the "Hunting Gear", as its name implies, is to so control the steering engine and thus the rudder that the latter "hunts" or follows the movements of the steering wheel.

The essential feature of the device is the control valve which serves the dual function of starting and stopping the engine and also of determining the direction of rotation according to whether it is moved to the right or to the left of its central or "off" position.

The control valve is moved in the first instance by the steering wheel, but it is also driven slowly by gearing from the engine so that it always returns to the central or "off" position.

The sequence of events is as follows:—The helmsman moves the steering wheel to port or starboard. Immediately the control valve moves from the "off" position and admits steam to the steering engine, which revolves and moves the rudder to its new position. At the same time the valve is being slowly returned by the engine to the "off" position. When it reaches this point it shuts off the steam and the engine stops. The rudder then remains in its new position until the steering wheel is again moved.

The steering engine contains a large barrel, usually athwartships, to which lengths of chain are fastened, one passing under, the other over, the barrel. When the barrel revolves, one chain unwinds, the other winds up.

These chains are attached to rods leading aft to the quadrant,

but where any indirect lead has to be made lengths of chain are used. Chain is also connected to the quadrant by means of bottle screws for tightening the steering chains. At some part of the gear heavy spring buffers are fitted to take the kick off the steering engine.

It is not uncommon, with this type of steering gear, to have the old-fashioned hand steering gear on the poop. Strongly connected to the rudder head is a heavy crosshead (keyed to the head of the rudder so that the head must go with the rudder); attached to the crosshead are two connecting rods projecting aft. The spindle of the hand steering wheel contains two threads, one right, and one left handed revolving inside two large nuts or sleeves. When it is required to put the hand steering gear in action, the helm must be kept amidships. The connecting rods from the crosshead are placed in recesses in the nuts and connected by heavy pins; then the steam steering chains must be detached from the quadrant.

It may be seen that the action of turning the hand steering wheel revolves the spindle inside the nuts and has the effect of moving them along the spindle. This means that the crosshead must move and with it the rudder.

Whenever the sea is other than smooth, it is necessary to have relieving tackles rove, otherwise it becomes impossible to hold the wheel. A good relieving tackle can be formed by the use of four double blocks, a single one and a luff tackle.

Shackle two of the double blocks to the tiller and the other double blocks, one on each side of the deck to handy positions. Now reeve a 4-inch manilla through one of the blocks on the quadrant back through the side block, again through the quadrant block and side block, across the deck, then through the side, quadrant, side and quadrant blocks. You now have the two ends of the rope; make one end fast to the bitts, reeve the other through the single lead block, clap on the handy billy and bowse all taut. Smear the fall of the relieving tackle with plenty of tallow to save chafe.

Some steering gears have the engine close to the rudder head and it is geared direct to the quadrant. This obviates the use of chains and rods along the deck. In these gears it is usual to

have buffer cylinders fitted to take all jar off the steering engine. These cylinders are filled with oil and are connected to each other by small flow through pipes.

Another steering gear which is in common use is the telemotor. In this system, the steering engine is actuated by pressure imparted through copper pipes leading from the bridge.

Briefly, it may be explained as two hydraulic cylinders connected by two flow and return pipes. One cylinder is placed on the bridge, the other is placed beside the steam steering gear. When the wheel is revolved it causes a hydraulic piston to force the liquid from one end of the cylinder on the bridge, along the pipe leading to the cylinder aft, and so causes the control valve to move in the desired direction. The other pipe acts as a return to the opposite end of the cylinder, thus relieving the back pressure on the piston of the after cylinder. The liquid used is of a non-freezing character, oil or glycerine.

In many large, modern liners electric motors have superseded the steam engine.

Duties in getting ready to proceed to sea.—See that the steam is on deck for winches and windlass. Steam on the whistle. Try the telegraphs. See all clear aft and try the helm over each way. Proper charts out, compasses shipped in the binnacles, binoculars in boxes. All steaming lights ready; hawsers, mooring lines, heaving lines, fenders, etc., ready. Have all hatches on and battened down, derricks lashed or clamped in their crutches; also that movable things about the deck are securely lashed. Winches in proper gear. Log and leadlines ready.

Should the vessel be going out of dock, stern first, be extremely careful that no warps foul propeller, therefore attend to the after signal in good time to notify the bridge should the occasion arise.

When taking over the bridge at night at sea always read the night order book and sign it. Be careful to obtain the correct course and to see that it is being steered, and that all lights are burning brightly. Note the vessels in the vicinity so that you know how to act with regard to them. Find out the state of the deck whether hatches are open. (Some vessels with coal cargo allow the end hatches to be off in moderate weather for ventilation purposes, being easy to batten down should there be need. Also one of the side bunkers will most probably be open for the use of the firemen.)

A CHAPTER ON SAILING SHIPS

THIS may be read with advantage by all candidates, especially the part relating to "Rattling down" and "Sending up a topmast."

SENDING UP YARDS, MASTS, ETC.

Sending up the Main-Top.

Have two gantlines placed aloft at the mast-head, then get the top in position at the after side of the mast, underneath side forward, and make fast to the after part of the top, stop them to the middle and fore-part, have two guys, one leading forward and another aft, to steady it when going up, also to help it over the mast-head; when high enough, cut the upper stops, hoist away and then cut the middle and lower stops, haul on the guys as required to cant it over the mast-head, then lower away and secure it into position on the trestle-trees.

When taking on board a lower-mast, the tops are generally placed over the mast-head, when the head of the lower mast comes above the rail.

Sending up a Lower Cap.

The cap should be hauled up to the top, and placed with the round hole over the square hole in the trestle-trees. When the top-mast is sent aloft, and when the head points through the trestle-trees, lash the cap to the topmast head, hoist away, and when high enough slue the topmast, place the cap over the lower mast-head, and fix it into its proper position.

Sending up a Topmast and Trestle-Trees.

Get the mast alongside with its head forward, hook a top-block on the eye of the lower cap, reeve a mast-rope

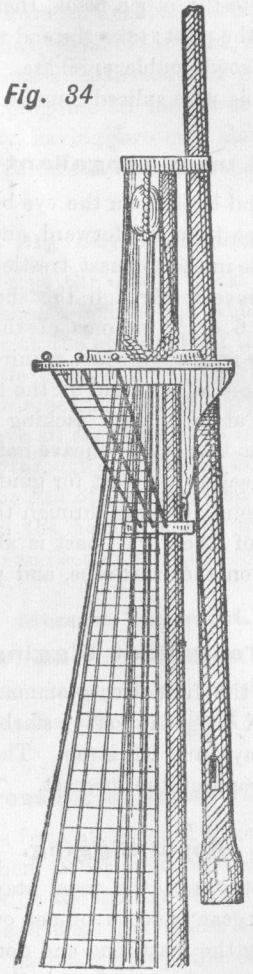
through the block, make the end fast about the middle of the mast, and heave it on board; then cast off the mast-rope and pass the end down through the hole in the trestle-trees and through the sheave-hole in the heel of the topmast; overhaul enough for doubling the gantline, then rack the two parts of the mast-rope together, hoist away, and when high enough double the mast-rope, come up the racking, then hoist away, and when the topmast is a few feet above the lower cap, lash two gantline blocks on the topmast head, reeve the gantlines from forward aft, bend them on and send the cross-trees up. Place them so that the after-part may rest on the lower cap, and the fore-part leaning against the topmast. Now lower the mast gently until the cross-trees fall into their place, then hoist away; fid the mast, and rig the topmast rigging, place the bolsters in position, and the rigging in the following order:—First, the starboard rigging, then the port rigging, starboard backstays, port backstays, and last of all the topmast stay and lift strop.

The foretopmast stay should have a large eye to go over the mast-head; the stay leads down under the fore leg of the cross-trees. To set the gear up, first set the topmast stays, next the back stays, and last of all the rigging, which is set up in the top.

Sending up a Topmast.

Place a block at the mast-head, the fall rove from aft forward down between the trestle-trees through a lead (or lizard), then through the sheave-hole in the heel of the mast, up through another lead on the other side, then make the end fast to the eye-bolt on the lower cap. The leads will keep the mast on end for pointing through the cap; when the mast is pointed cast them off.

Fig. 34



For a heavy topmast, have a block at each side of the cap, then reeve the purchase from aft forward through the sheave-hole of the mast and up to the other block, then down and through a block at the heel of the mast; take the end up and make fast at the cap, which makes a good double purchase. A lizard can be made with a piece of flexible wire spliced round a large thimble.

Send up a Topgallant Mast.

Send a block up and hook it on the eye-bolt in the topmast cap, reeve a good mast-rope from aft forward, and overhaul it down on deck through the hole in the topmast trestle-trees and the collar of the topmast stay; reeve it through the sheave-hole of the mast, and overhaul about 6 or 7 fathoms of the rope, so as to have enough to double the mast-rope when required, then hitch the end through the sheave-hole at the head of the top-gallant mast round its hauling part. Put on a good racking on both parts of the mast-rope just above the lower sheave-hole; also, make fast a tripping-line to the heel of the mast for guiding it up. Now hoist away the mast and point its ends through the topmast cross-trees, and when the head of the royal mast is about 2 feet above the topmast cap, hold on the mast-rope, and place the rigging over the mast-head.

Topgallant Rigging.

First of all place the funnel or grommet over the mast-head; next, the fore-and-aft topgallant stay, starboard pair of shrouds, port shrouds, back stays, and lift strop. The topgallant rigging is set up to the spider band on the topmast.

Royal Rigging.

First, the grommet; next, the royal stay, backstays, and lift strop. After all the gear is on in proper order, hoist the mast a few feet higher, belay the mast-rope and double it, now haul taut the mast-rope from the racking, and make it fast to the cap, come up the racking, hoist away, and fid the mast.

Send up a Topgallant Yard.

Place a block at the topgallant mast-head, reeve a fall from aft forward, overhaul it down on deck, and bend it to the yard amidships; stop it out on the quarter of the yard, fit on the lifts and foot ropes, and send the braces aloft ready for going on; as the yard goes aloft, have a tripping-line on the lower yard-arms, and when all is ready hoist away, having two men aloft to guide the yard; when high enough, parral the yard, make fast the lifts, foot ropes, etc.

To Rig out a Jibboom.

Reeve a good heel-rope through a block at the bowsprit end, then in through the sheave-hole of the jibboom heel, overhaul it and make the end fast on the other side of the bowsprit cap; next heave the boom a little outside the bowsprit cap, fit on the iron band, put on the foot-ropes, guys, and martingale stay, reeve the flying jib stay, and have all the other stays rove through the hanks and ready for reeving through the hole in the jibboom; make fast the jib halliards on the end of the boom and have a man to attend them, heave away on the heel-rope, and when the boom is out place down the clamp and set up the gear.

Mizzen Topmast.

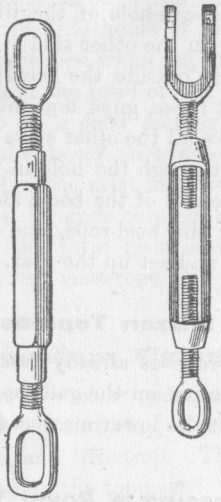
Reeve off the mast-rope as already described—if the vessel is a barque do not forget to put on the gaff topsail hoops—then all the other gear should be at the lower masthead ready to place over as the mast goes up.

Crossing a Royal Yard.

Reeve the halliards from aft forward through the sheave-hole in the mast, overhaul them down on deck and bend it to the yard amidships, stop it out on the quarter of the yard; next put on the lifts and foot-ropes, and send the braces aloft ready for going on as the yard goes up, have a tripping line on the lower yard-arm, hoist away when high enough, parral the yard, and secure the foot ropes, lifts, etc.

Screw Rigging.

All modern vessels are now fitted with standing rigging made of wire, and screws for setting it taut. Compared with lanyard rigging, it is a much easier matter to stay the masts and set up the rigging. However, the principle is the same, viz., to have the mast set upright and all the shrouds bearing an equal strain; if the mastcoat is properly fitted on, it is a guide when setting up the lower rigging to see that the mast is at an equal distance from the partners. Always stay the mast, then set up the rigging, starboard shroud first, then the port shroud, etc.



After all stays and shrouds are set up, the screws should be properly cleaned and coated over with a mixture of white lead and tallow, and then covered over with canvas, so that the screws will be kept dry and free from rust. To prevent the screws from working loose, a piece of wire-rope is rove through the box-hole of the foremost screw and made fast, then through all the other screws and hove taut and made fast on the after shroud.

Rigging.

Standing rigging is shrouds, back stays, and fore-and-aft stays, which are fixed and stationary, and are used for keeping and supporting the masts, bowsprit and jibboom in position.

Running gear is ropes which reeve or work through blocks and sheave holes, such as halliards, braces, sheets, downhauls, clew lines, buntlines, leech lines, spilling lines, brails, vangs, derrick guys, etc.

To set up the rigging is to haul it taut by means of the lanyards, which are rove through the dead-eyes.

Dead-Eye.—A circular piece of wood with three holes in it, and a groove cut round the outer edge for the shroud to lie in. It is used for turning in the ends of shrouds and backstays, and the three holes are for the purpose of reeving the lanyard through, when setting up the shroud or backstay.

To Reeve a Lanyard.

On the starboard side, reeve it through the after-hole of the lower dead-eye, then up to the after-hole in the upper dead-eye, and finish off with a Matthew Walker knot on the foremost hole of the upper dead-eye.

When the lanyard is set up how do you secure it?

With a back and front racking. Afterwards finish off with throat, quarter, and end seizings.

If your lower rigging is sent on board cut to a plan, you will know the port shrouds because they are a little longer than the starboard ones, which are placed over the mast-head first.

To Send up Lower Rigging.

Starboard shroud first, then the port one, etc. Bend on the gantline a few feet below the eye of the shroud, then stop it to the eye, hoist away, and when high enough cast off the stop and guide it over the mast-head, sending a man aloft with tar and a mallet to hammer it into position.

To Set up Lower Rigging.

To set up the fore-stay on end, reeve a good purchase from the lower mast-head to the knight-heads, heave the mast forward, and then set up the stay with a luff tackle purchase. Next, to set up the starboard and port shrouds, reeve off two good luff tackles, one on each side of the lower mast, also a runner on each side—the runner is made with a single block and a line rove through it, also a toggle for making fast the lanyard, or, luff upon luff. Come up the two foremast lanyards, and as the starboard foremast shroud is placed over the mast-head first, set it up first, then the port foremast shroud, keeping the same order until they are all set up.

The rigging aloft rests on smooth wooden bolsters, which should be tarred before the rigging is set up; the eyes of the rigging should also be examined and parcelled, and served if necessary.

When setting up the lower rigging the officer in charge should see that the mast is kept upright in its proper position, *i.e.*, have it even all round with the partners. If the rigging must be cut it is advisable to draw a plan—$\frac{1}{4}$ of an inch to the foot makes a good working plan.

To Set up Topmast Rigging.

Set up the fore topmast stay, then the rigging and backstays. The topmast rigging sets up in the top, and can be set up with a handy watch tackle, the fall leading down to a winch on deck. The topmast backstays lead down to the deck. The topmast rigging is rattled down in the same way as the lower rigging.

Head Gear.

The bowsprit is secured by setting up the bobstays and bowsprit shrouds.

The jibboom is secured by setting up the back-ropes, guys, etc., then the headstays, and afterwards the topmast, topgallant, and royal backstays.

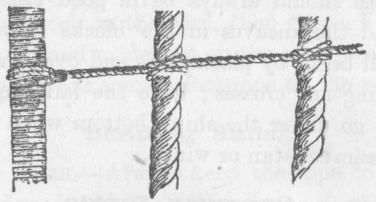
Rattling Down.

Get all the gear ready and stretch the ratline, swifter in the

rigging, but not too tight, place spars (oars will do) fore-and-aft, about 5 feet apart, then see that the sheer-pole is in position, in a line with the sheer of the vessel.

The man who rattles down will require a marline-spike, tar and grease pot, also marline for seizings, and a wooden measure 15 inches. All the measurements are taken from the sheer-pole.

The ratline should be coiled down abaft the rigging, beginning on the main rigging on the starboard side, by placing a clove hitch on the after shroud but one, then working forward until the foremost shroud is reached; next make a neat eye-splice in the end of the ratline, and seize with a cross seizing to the shroud, measuring up 15 inches from the sheer pole; now work aft, heaving taut the hitches, cut the line at the right length, make a neat



eye-splice and seize it on the last shroud at the correct length from the sheer-pole. Then begin with the next ratline, by placing a rough clove-hitch on the last shroud but one, and work forward from right to left, tightening up from left to right. All the hitches are made on the outside of the rigging (see above). Care should be taken that the measurements are made correctly between the ratlines—the usual length is 15 inches. As you work up, place wooden battens to stand on, and also to protect the ratlines until the work is finished.

Every fifth ratline is generally termed a *catch ratline*, and is extended abaft the rigging to the after shrouds.

Wooden leads are also seized on the lower rigging a few feet above the sheer-pole, through which the running gear is rove.

Running Gear.

When reeving off new gear, the lead should be direct and clear so that it will work smoothly and not get cut or chafed. Jib halliards are rove from aft forward through a block at the mast-head down to the forecastle head, and cut at the proper length.

The jib downhaul is rove through a block on the boom (the block being seized on the stay), then made fast to the head cringle of the sail, long enough to allow the sail to be hoisted up, and the end of the hauling part is made fast easy on the forecastle head pin-rail.

All running gear should be cut on the big side. To begin with a new coil of rope dip the end down through the coil; it will then run free of kinks and turns.

Cat Fall.

This purchase should always be in good order, the rope fresh and strong, and the sheaves in the blocks running freely. To reeve a new fall begin by placing the end over the middle sheave, and avoid having any crosses; have the fall long enough for the lower block to go under the ship's bottom when the hauling part is round the steam capstan or winch.

Gangway Tackle.

This purchase should receive special attention, especially on board a steamer; more so, if passengers require to embark from small boats and have to climb the ladder. The tackle should be strong enough to bear any number of men who may get on the ladder; the man rope and stanchions should also fit well in their respective sockets, and a guess rope should be made fast from forward aft for boats to get hold of.

Topsail Yard.

Gear required—lifts, foot-ropes, buntline blocks, brace pennants to shackle on the yard-arm eye bolts and braces. A lower yard will also require leech-line blocks, clew-line blocks, reef tackles, etc.

Braces.

To reeve off new braces, brace the yards up fore-and-aft, then marry the new rope to the end of the old brace, overhaul and coil down the old brace, then cut the proper length, and whip the ends with a palm and needle.

Jib Downhaul.

Dip the end of the new rope through the coil, pass the end through the downhaul block on the jib stay, then clench the end to the head cringle of the sail, hoist away on the halliards, and when the sail is up cut the downhaul the required length.

Upper Topsail and Yard.

Gear on the yard—foot-ropes, lifts, buntline blocks, brace pennants, and braces. The spilling lines are rove through a lead, then through a hole in the top and up to a block at the mast-head, down through the block on the yard, then through the foot of the sail on the fore part and made fast on the yard, abaft the sail.

A Flemish foot-rope is a small foot-rope on the yard-arms.

Bending Sails.

Fore-and-Aft Sails.—Always keep the rope to port, and send them out to windward with the halliards and downhaul.

Square Sails.—The rope is on the after part of the sail; to send them aloft have a block at the mast-head with a good gantline, have the sail stretched out, rovings rove and head-earings spliced in. Make the sail up with the clews out, and the grommet holes clear for bending on the gear, hoist the sail, haul out the head-earings, make fast the rovings, and bend on all the gear. Buntlines, etc., are made fast with a half hitch which jams (clench), and a mousing put on the end part with a ropeyarn. The officer aloft should see that the midship stop (bunt) is first made fast, and also see that all the gear is secured without any turns or crosses, and clear for running.

Send up a Topsail:—Send a block aloft and hook it on the cap at the mast-head, reeve a gantline from aft forward, overhaul

it down on deck and make it fast around the bunt of the sail, splice in the head-earings, and make them fast to the gantline; hoist away, and when high enough, make fast the bunt stop, then haul out the head-earings, and make fast the rovings and buntlines, shackle on the sheets, etc., and stow the sail.

Send up a Foresail.—Get the sail across the deck, overhaul the buntlines, leechlines, reef tackles, and clew garnets, make them all fast to the sail, then hoist away on the midship gantline and reef tackles; when high enough lay aloft and bend the sail by making fast the midship stop, next haul out the head-earings, and then make fast the rovings, etc.

Bend a Spanker.—Stretch the sail out, and have the luff and head clear with the hanks all rove, next reeve a good gantline from the mast-head and make it fast around the sail; hoist away, guiding the hanks on the traveller as the sail goes up; when the luff is high enough, bend on the head-hanks and make fast the downhaul, brails, etc.

Send a Jib out and Bend It.—Make it up on the luff, rope to port, make fast the halliards and downhaul, have a line made fast to the clew. Then hoist away, when high enough, haul it out by the downhaul; when out, get on the tack, make fast the rovings, halliards, and downhaul, then shackle on the sheets.

Send up a Top-Gallant Sail and Bend It.—Send a block aloft, reeve a good gantline from aft forward, overhaul it down on deck, stretch the head of the sail on deck and have the earings spliced in, also the rovings rove; bend on the gantline and hoist away; when high enough haul out the head-earings, make fast the rovings, get on the buntlines, clew garnets, sheets, etc.

Send up a Royal and Bend It.—Reeve a gantline from aft forward and overhaul it down to the deck, bend on the middle of the sail, and hoist away; when high enough make fast the bunt roving, then haul out and make fast the head-earings and the rovings, reeve the buntline and make it fast with a clench hitch and seize with a rope yarn; next make fast the clewlines, and stow the sail.

Bend a Trysail.—Fit on all the gear, the brails are seized on the bight to the after leech, have a good gantline from the mast-head, overhaul it down and bend it round the sail, hoist away and guide on the hanks to the traveller on the mast; when up, fit on the head hanks to the jackstay on the gaff, make fast the head, out-haul, and all the other gear.

TAKING BOATS ON BOARD.

In a steamer overhaul the tackles and see all clear; the boat being alongside and the painter passed forward, let all the men come out of the boat except two; hook the bow tackle on first, take in the slack, then hook on the after tackle and hoist away. When high enough belay, take the plug out and let any water run out, then launch the bow of the boat forward and inboard, next straighten the boat fore-and-aft in the davits, lower down gently and fit in the chocks. Then have the boat cleaned and all the gear snugly stowed away ready for use, the gripes secured and the cover placed over all.

Sailing Vessel.

To take on board a heavy boat, top fore and main-yards up a little, and put a preventer on each yard to the mast-head. Have both yards braced up with the same drift as the length of the boat between them. Rig a yard arm and midship purchase, *i.e.*, luff tackle purchases, overhaul and hook on the lower blocks and hoist away. If the vessel is long and the space between the masts great, it is advisable to rig a span for the midship purchase.

Sailing Vessel.

To take in a small boat, use the royal or top-gallant halliards, or use a single tackle; pass a span underneath both ends of the boat, hook on the tackle, have a cross on the span over the hook so as to prevent its slipping, then hoist away; when high enough ease it on board and lower it down.

To take on board a small dinghy or a light boat, if the boat painter is good and strong, reeve it from forward aft through the

eye-bolts in the stem and stern, forming a sling; cross the parts in middle over the hook of the tackle and hoist away.

GETTING READY FOR SEA.

(Sailing Ship Certificates.)

Before leaving the docks to proceed to sea, take the vessel's draught fore-and-aft; send down all the cargo gear, make it up snug, and stow it away for future use. Have the hatches battened down, the decks cleared up, and secure all movable gear about the decks. Sound the wells, ballast tanks, also the fresh water tanks. See that the windlass is in working order, the anchors all ready, examine the steering gear, and have the lead and log lines handy, the compasses in order, and in the night-time have the lights trimmed and ready for use. The life-buoys should be in their respective places, and all the boats in order with their gear complete, and one boat handy for lowering; also have heaving and hauling lines, etc., ready for use.

Clear Hawse.

Begin a little before slack water, lash both cables together, and put a preventive line on the cable which you intend to unshackle; at slack water unshackle and take the turns out, then shackle on and heave taut the cable; come up the lashing, and cast off the preventive line.

Getting under Weigh.

At single anchor, wind ahead, get under weigh on the port tack. Heave short, mast-head the upper topsails, and place the after-yards on the port tack, and the head-yards aback on the starboard tack; loose the lower topsails, but keep the bunt fast, hoist up the fore-topmast stay-sail sheet to port, weigh anchor, and the head-yards will now box her off, when the after-yards fill; steady the helm, haul round the fore-yards, sheet home the lower topsails, and make all sail.

MANŒUVRING A SAILING SHIP AT SEA.

Steering.

The helmsman on board a sailing vessel stands on the weather side of the wheel. The order "down helm" means to bring the vessel's head closer to the wind; "up helm" means to let the ship's head go off, or away from the wind. The order "port," or "starboard," is seldom given except in narrow waters, or when a pilot is on board, or if the vessel is scudding before the wind.

When a vessel is sailing as near the wind as possible, the yards are braced sharp up and the weather clews of the royals are on the shake, or lifting.

Full-and-by means that the yards are just off the backstays, and the royals are not allowed to shake; the sails are all kept clean full; when the wind is abaft the beam the yards are checked in by hauling on the weather braces, and the vessel is now going free. Wind on the quarter, or dead aft, the vessel is running or scudding before the wind.

In the night-time you can steer better by watching the stars which are a little on the weather bow; the reason for this is that the ship's head will move quicker than shown by the compass. If a vessel is in good trim and nicely steadied on a wind, she will steer with very little helm.

A good helmsman will never require to give the vessel much helm, and whenever you see a man making hard work at the wheel, you may be sure he is not a skilful helmsman.

In bad weather relieving tackles are hooked on the tiller head, and set up to port and starboard; the purchase is double blocks and a lizard with an endless fall.

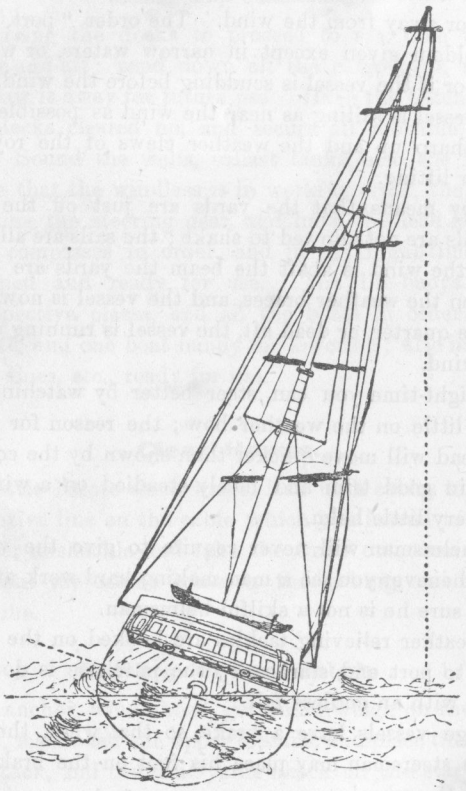
Some large vessels have a brake, so that when the rudder is kicking, the steersman may place his foot on the brake, and keep control over the wheel.

Why a Vessel carries Weather Helm.

If the masts of a vessel are upright, the wind strikes the surface of the sails and exerts its force in a line at right angles to the

surface; as the vessel heels over this line must alter (*see* fig. 35) and each square sail becomes a depressing sail, forcing the bow into the water; this, having no surface to act against, presses the lee

Fig. 35.



bow up towards the wind. In sailing vessels the run is kept as fine as possible; in consequence the centre of buoyancy is well forward of amidships. Wher the vessel heels her centre of

buoyancy moves forward, and when it passes the centre of effort of the sail plan weather helm is required in a lesser, or greater, degree corresponding to the heel of the vessel. There are two methods of countering this condition.

1. Trimming the vessel by the stern in order to get the centre of buoyancy as far aft as possible.

2. Reducing sail aft, *i.e.* brailing in the spanker or taking in the mizzen staysails in order to move the centre of effort forward.

Trimming Sails and Yards.

When the wind is dead aft, it blows straight against the sails, and the whole force exerted is to send the ship ahead away from and before the wind. When the wind strikes a sail obliquely it has not so much effect as when striking it at right angles, consequently, a vessel will not do her best when the yards are braced up sharp fore and aft.

With the wind before the beam and all the yards and sails in good trim, the vessel sails ahead, but at the same time she goes sideways, making leeway.

With the wind abaft the beam and all sail set flat, and nicely trimmed, the vessel is forced ahead at her greatest speed and will steer with very little helm.

Yards.

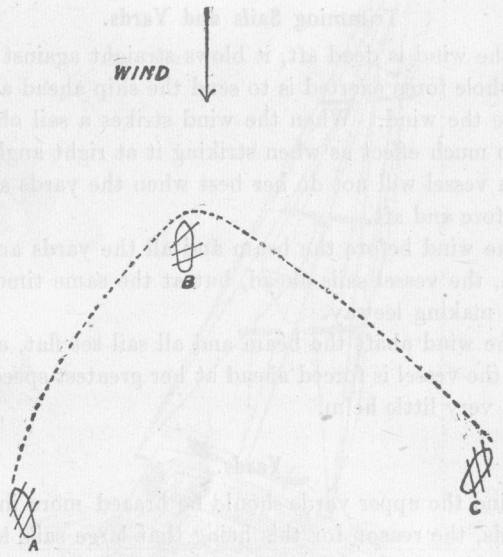
On a wind the upper yards should be braced more in than the lower-yards, the reason for this being that large sails have more curvature than small ones; consequently, for the plane of both sails to be at the same angle with the fore-and-aft line, the yards of the large sails should be braced up to a finer angle than the yards of the small sails.

Tack Ship.

Keep her clean full, see all clear for going about, haul the

clews of the mainsail up, spanker boom amidships, braces all clear and ready for running, and all hands at stations. When all is ready put the helm "hard-a-lee," ease off, and then let go the head and fore sheets; when the vessel comes about 1½ points from head to wind, mainsail-haul, and over with the head sheets; when the wind gets on the other bow, and the ship falls off, fore bowline, let go, and haul round the head-yards and trim all sail to best advantage.

Fig. 36



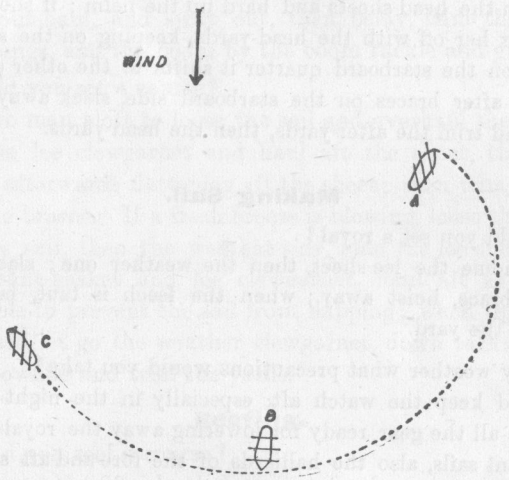
A. Braced up on the starboard tack, clean full for stays.
B. Ship one point from the wind, hauling round the after-yards.
C. Ship now braced up on the port tack.

To Wear Ship in Fine Weather.

See all clear, braces coiled down, raise the clews of the mainsail and brail in the spanker, put the helm hard up, and as she falls

off keep squaring the after-yards; when the wind comes on the other quarter haul round the head-yards, shift over the head sheets and staysails, brace up the yards and trim all sails; be careful to meet her with the helm.

Fig. 37



A. Ship on the port tack, helm put hard up.
B. Wind aft.
C. Ship now on the starboard tack.

Wind Shifting.

Braced up on the port tack, all sail set, the wind shifts in a squall to 6 points on the starboard bow. Put the helm amidships, lower down the light sails, brail in the spanker, haul the courses up, and haul the main-yards round (the head-yards will box her off); when the after-yards fill, steady the helm and haul round the fore-yards, and then trim yards and sails to best advantage.

Braced up on the port tack, the wind veers aft. Square the after-yards by hauling on the weather main braces. A man goes to

leeward and eases off the lee-braces, and the officer stands to windward and gives the necessary orders for trimming the yards; do not forget to let go the lee, fore and main lifts.

Wind dead aft, it shifts right abeam.—Lee fore brace, trim the head-yards, and then the after-yards.

Braced up in light winds, you are caught aback forward.—Flatten in the head-sheets and hard up the helm; if she does not go off, box her off with the head-yards, keeping on the same tack.

Wind on the starboard quarter it shifts to the other quarter.—Man the after braces on the starboard side, slack away the port braces, and trim the after-yards, then the head-yards.

Making Sail.

How would you set a royal?

Haul home the lee-sheet, then the weather one; slack off the lee brace, hoist away; when the leech is taut, belay, then trim the yard.

In squally weather what precautions would you take?

I would keep the watch aft, especially in the night-time, and have all the gear ready for lowering away the royals and top-gallant sails, also the halliards of the fore-and-aft sails ready for letting go.

If braced up and a squall comes down suddenly, what would you do?

Hard up the helm, let go the spanker boom sheet (to assist her to pay off) take in the light sails, and brail in the spanker; after the squall passes, set sail again.

How would you set the fore topgallant sail?

Loose the sail lee-side first, overhaul the gear and haul home the sheets, let go the lee brace and royal sheets, then hoist away; when the leeches of the sail are taut, belay the halliards, and trim the yard by the braces.

How would you set a jib?

Loose the sail, let go the down-haul, haul aft the slack of the sheet, and hoist away on the halliards; when the tack is taut, belay, then flatten aft the sheet. When hoisting a fore-and-aft sail a man should attend the sheet.

How would you set a spanker?

Loose the sail, let go the head in-haul and the brails, haul aft the slack of the sheet, haul out the head; then man the foot out-haul, and sway out, then belay, trim the gaff by the vangs, and the boom by the boom tackle and guys.

How would you set a course?

Send two men aloft to loose the sail and overhaul the gear, let go the lee clewgarnet and haul aft the sheet, then down tack, afterwards flattening aft the sheet; then trim the yard by the braces. If a fresh breeze is blowing, loose the lee side of the sail, then the weather side, man the lee sheet, let go the bunt-gasket and lee clewgarnet, haul aft as soon as possible to prevent the sail from flapping; when the sheet is well aft, let go the weather clewgarnet, down tack, haul out the bowline and trim the yards.

Reefing.

How would you reef a course?

Steady taut the lifts, haul the sail up in the same way as if you were going to furl it, ease off the leechlines, and haul out the weather reef tackle, then the lee one (the second mate should be at the bunt, to carry on the work), then make all the reef points fast with reef knots.

To set the sail, haul aft the lee sheet, then down with the tack, or if the vessel is running before the wind, haul aft both sheets, and trim the yard by the topping lifts and braces.

How would you reef an upper topsail?

Lower the yard down, take in the slack of the weather brace, then send the men aloft (the second mate at the bunt); have the weather earing hauled out first, then the lee one, afterwards making fast the reef points. When the men come on deck

let go the lee brace and topgallant sheets, and hoist away on the halliards; when high enough belay, then trim the yard.

How would you reef a spanker?

Lower the gaff down a little, pass the reef-earing through the after leech cringle and the clew, also the reef-earing at the tack and hoist of the sail; make fast all the reef-points, sheet home, set the sails, and trim the gaff and boom.

If a spanker reefs on the after-leech, you must brail in the sail, then lace down the after-leech from the head to the clew, and set the sail by letting go the brails and hauling aft the sheet.

How would you shake out a reef of a course?

Ease off the tack and the sheet, haul taut the reef-tackles, lay aloft and let go the reef-points, beginning from the bunt, ease away the lee reef-earing and then the weather one, down tack, haul aft the sheet, steady taut the lifts, and trim the yard.

How would you unreef and set the upper topsail?

Lower the yard, cast off the reef-points from the bunt to the yard-arms, come up the reef-earings, ease off the lee one first then the weather one, let go the lee-brace and topgallant sheets, and overhaul the gear, then hoist away and set the sail; next trim the yard, coil up the gear and have the halliards clear for running.

How would you bend a topsail in a gale?

Reeve off a good gantline from aft forward and overhaul it down on deck, make the sail up snug on the foot, bend the rovings and have all the gear ready; hoist the sail up to windward and guide it aloft with a tripping line from the deck; when high enough bend on all the gear, and bend the sail to the yard without undoing the stops, then make the sail fast with the gaskets and cast off the stops; the sail is now ready for setting when required.

To Shorten Sail.

How would you take in a royal?

Lower the yard down, check in the weather-brace, clew it up snug, and haul up the buntline, then furl it.

How do you take in a topgallant sail?

Lower down the yard, haul in the weather-brace to spill the sail, haul up the lee clew-line, buntline, and leech-line, then the weather side, stow it, and trim the yard.

How would you take in a lower topsail?

Check in the weather-brace, then haul up the weather clew-line and buntlines, next haul up the lee gear, and trim the yard, and lay aloft and make it fast.

Taking in a Course.

How would you take in a course?

Steady taut the lifts, ease off the lee sheet a little, man the weather clewgarnet, buntlines, and leech-lines; when the weather gear is up as high as possible, belay all, man the lee-gear, haul it snug up, stow the sail and trim the yard.

How would you take in a jib in a breeze of wind?

Man the down-haul, let go the halliards, and have a man to ease away the sheet. When down, furl it, steady taut the sheets and halliards.

How would you take in a spanker?

Man the head in-haul, also the lee-brails, let go the head out-haul and slack away the sheet, and brail in the sail close to the mast; trip the clew up inside the brails and furl the sail.

How would you take in an upper topsail?

Lower the yard down, check in the weather-brace, haul up the spilling lines, then lay aloft and furl the sail. When the men come down on deck steady taut the braces and coil the gear up.

DEEP SEA SOUNDINGS.

It is absolutely necessary that soundings should be taken frequently in thick or foggy weather, and the vessel's position (from the soundings) fixed on the chart.

Sailing Ship Running.

In moderate weather, haul the cross-jack and mainsail snug up in the gear, also lower the royals; have the lead armed, pass the line forward on the weather side, and station the men with small coils of the lead-line in their hands ready for use. When all is ready brace up the head-yards, put the helm down, and bring the ship to the wind. The head-yards are now full and the after-yards square, the ship being hove to. Give the order to "Heave the lead." The men now drop the line and pass the word along, "Watch there, watch." The officer obtains up and down soundings; pass the bight of the line in a snatch block which has already been made fast on the after rigging, haul the line in, and note the nature of the bottom from the arming on the lead; then put the helm up, set sail, and steady on your course.

Sailing Ship Braced-up.

See all clear, and station the men with the lead-line passed forward on the weather side, and have the lead armed; haul the mainsail up, steady the helm, square the after-yards, the ship is now hove to. Obtain two good casts, note the soundings and the nature of the bottom. Then fill on the after-yards and set sail to best advantage.

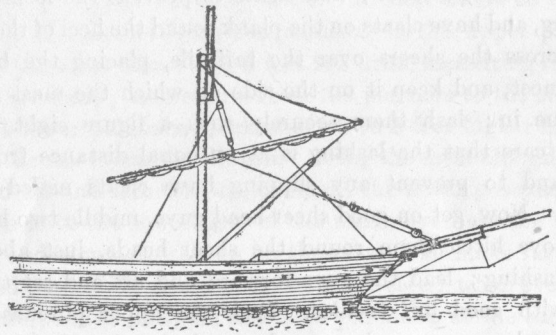
Heavy Weather, Running.

Running in heavy weather, to obtain soundings it is necessary to take in sail to the lower topsails, watch for a favourable opportunity, let the head-yards go forward, also the after-yards, and heave the ship to—oil may be used to advantage. If the ship is making much leeway the line can be passed round to the lee bow. After taking good reliable soundings put the helm up, square the after-yards, set sail, and steady on her course before the wind.

Send up a Fore Yard.

Get a good steel wire strop aloft, and parcel underneath so that it will not chafe on the lower cap, then reeve off a good three-fold purchase, overhaul it down between the two parts of the stay, and then lash it to the middle of the yard. Also have a gun-tackle purchase from the yard well out on the bowsprit, so as to steady the yard in position for slinging and trussing.

FIG. *38*



The yard should be placed across the rails, and all the gear fitted on, braces, lifts, foot-ropes, etc.; then when all is ready hoist away, and when high enough sling and truss the yard, then ease down on the main purchase, steady taut the lifts and braces.

Shifting Spars.

Always have a good purchase rove, and the falls not too stout, so that the parts will work freely; shifting spars, a few round rollers made of wood, placed underneath the spars, and a handy watch tackle, with a few men, are all that are required

to move about heavy spars. Screw-jacks are also useful for raising heavy weights.

Rigging Sheers.

To take a lowermast on board two good spars are required about seven-eighths the length of the mast, and to get the sheers on board you will require to rig a small derrick. When the sheers are on deck, place each heel on its own side with a broad plank underneath, and resting on a beam, have the deck shored up underneath, then lash the sheers to stanchions, but do not have the lashings taut; nail cleats to prevent the lashing from slipping, and have cleats on the plank round the heel of the sheers. Next cross the sheers over the taffrails, placing the best one uppermost, and keep it on the side on which the mast is going to come in; lash them securely with a figure eight lashing, taking care that the lashing is at an equal distance from each heel, and to prevent any slipping have cleats nailed on the sheers. Now, get on good sheer-head guys, middle two hawsers, and clove hitch them round the sheer heads, just above the sheer lashing; lead the guys forward and aft and set them up easy with good luff tackles. Lash the upper purchase block with good new rope above and round the sheer-head lashing, so that the block will hang free. Reeve the main purchase and make the standing part fast round the upper sheer-head, then reeve another purchase for topping the mast, also two gantline blocks, with lines rove through them.

Next, pass a few turns of chain through each hawse hole and round the stem, lash the lower block to this chain, and take the fall to the windlass and heave away. When the sheers are well up, place a good tackle on each sheer leg, low down for placing them in position. Secure the heels, set taut the guys, and have all in order for taking the lower mast on board.

Before lashing the upper purchase block, have the sheer-head lashing well parcelled over; also examine the pins and sheaves

of the blocks, and see that all the gear used is in first-class condition.

When the sheers are in position they should rest firmly over a beam a few feet before the mast hole.

Shipping a Mizen Lowermast.

Overhaul the main purchase and lash the lower block securely to the mast; have the hauling part on the opposite side to that on which the mast is coming in on. To find where to lash the lower block measure from the partners to the upper purchase block, then allow about 4 or 5 feet less drift, measuring from the heel of the mast; or measure from the partners to the step, and lash the lower purchase block about 2 to 3 feet higher from the heel of the mast than this length. Bring the mast alongside with its head aft and fore-side up, overhaul the lower purchase block and lash it to the lower part of the mast, overhaul the topping tackle, and secure it well up on the mast, also make fast a heel guy, and have skids placed over the ship's side; when everything is in order, heave away on the main purchase, at the same time taking in the slack of the topping tackle. When the heel comes near the rail, take a turn with the heel rope round the sheer leg to ease it inboard, at the same time have two handy tackles made fast to the mast, one leading forward and the other aft, then with these tackles get the mast fairly entered for lowering. When the masthead comes above the rail, the top may be shipped. When the mast is properly stepped cast off the sheer heel lashings, wet the decks, and fleet the sheers forward by easing away the after guys and heel tackles, and haul on the forward ones until you get the sheers placed in position just before the masthole; then set up the guys, secure the heel lashings, etc., shore the decks up, and take on board the main-mast in the same way as the mizen-mast. After the main-mast is in, fleet the sheers forward, and take the foremast on board in the same manner.

Bowsprit.

The bowsprit may be taken on board with sheers. Secure the foremast with good stays from the masthead leading aft, also shrouds; have a span from the masthead and let the sheers droop forward to the right position, and have good heel tackles on the fore parts, also on the after part; lash the lower purchase block to the upper side of the bowsprit outside the distance measured from the heel to the knight heads, have guys made fast to the outer end of the bowsprit, also a good guy on the heel, and the topping tackle lashed on the outer end of the bowsprit; then heave away on the main purchase. When high enough, lower away and ship it with the guys and topping tackle.

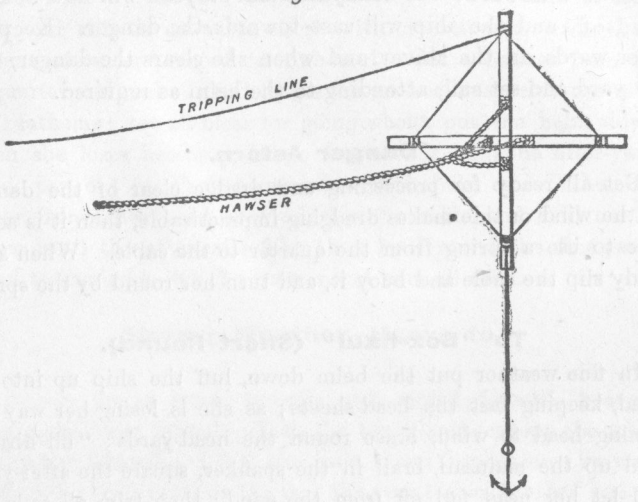
If the vessel is long and it is not convenient to ship the bowsprit with sheers, then rig a derrick with good up and down purchase, also a fore-and-aft spar with the inner end securely made fast; at the outer end of the spar have a luff tackle purchase block made fast, and on the outer end of the bowsprit have the inner block made fast; then hoist away on the main purchase, and at the same time heave on the fore-and-aft purchase. When the bowsprit is in position lower away and have it secured.

MANAGEMENT OF A VESSEL IN STORMY WEATHER.

Sea Anchors.

In a sailing vessel a sea anchor can be made from the royal or topgallant yard, with the sail bent and a weight attached to each clew, and a good hawser or running line made fast to the quarter of the yard; or one large spar with a chain bridle on the middle and a line made fast, so that it will float to windward and stop the vessel's drift, and help to keep her head to wind and sea. Or, if a vessel is in shallow water, unshackle the cables and pay out about 90 fathoms; the cables now dragging on the bottom will stop the vessel's drift and keep her head to sea.

Fig. 39



Sea Anchor.

A good sea anchor as above can be made with two spars in the shape of a cross. Get two stout spars about 12 feet long, or longer, place one spar over the other to make a cross; lash them securely together, then have wire or chain from each end of the spars right round. We have now a complete frame which will have to be covered over with canvas, seizing it on to the wire or chain ridge round the cross. Now have two chain bridles, one made fast to the up and down spar, the other made fast to the athwartship spar. On the bridles make fast the hawser by which the vessel is to ride, using plenty of parcelling. On the lower end of the cross, make fast a small kedge to sink it. On the upper end you must have a good line, which is required to steady the anchor; also to heave it alongside when the weather moderates.

Cast towards Danger.

To get under way with a danger abeam, masthead the topsails, heave short, square the after-yards and brace the head-yards aback. When all is ready up anchor, run up the fore-topmast staysail,

sheet to windward; the headyards and staysail will now box her head off, and the ship will cast towards the danger. Keep the after-wards on the shiver and when she clears the danger, trim the yard and set sail, attending to the helm as required.

Danger Astern.

Get all ready for proceeding and dredge clear of the danger. If the wind or tide makes dredging impracticable, then it is advisable to use a spring from the quarter to the cable. When all is ready slip the cable and buoy it, and turn her round by the spring.

To "Box-haul" (Short Round).

In fine weather put the helm down, luff the ship up into the wind, keeping fast the head-sheets; as she is losing her way and coming head to wind, brace round the head-yards; "all aback," haul up the mainsail, brail in the spanker, square the after-yards and let her head fall off from the wind; then trim all sails and yards to best advantage. In fine weather use the helm when the ship has sternway, but if blowing hard, keep the rudder amidships, and be careful when slacking away the weather head braces, as the wind, acting stronger on the weather half of the sail than it does on the lee, blows the yards forward by itself, and the slack of the lee braces have only to be hauled in when the yards swing round.

To "Box-haul," or, Turning Short Round in Stormy Weather.

The weather is too rough to tack ship, you have no room to wear, and the water is too deep for club-hauling, and with danger on the lee bow you turn short round.—See all clear, down helm and bring the ship up in the wind; when she has lost headway haul round the head-yards, and square the main-yards. She will now gather sternway; run the helm amidships and the head-yards will box her off. Keep the cross-jack yards shivering, and the after-yards lifting; as she falls off, shift the helm, brace up the after-yards, and the ship is brought to on the other tack.

Club-haul.

If your ship is on a lee shore with no room to wear in 12 fathoms of water proceed to club-haul.—Get a hawser from the lee quarter and make it fast to the lee anchor, unshackle the cable at 30 fathoms; see all clear for going about, put the helm down. When she loses headway, let go the anchor, haul the after-yards round, pay out to 25 fathoms cable, then hold on. When the anchor brings her head to wind, slip the cable, and hold on the hawser until the after-sails fill; then haul round the fore-yards, attend to the helm, cut the hawser and trim all sails.

Stormy Weather—Heave to.

Running under lower topsails and reefed foresail, heave-to under main lower topsail.—Take the topsails in, except the main, haul up the foresail and furl the sails, down fore-topmast staysail, brace up the head-yards on the tack the vessel is on, "lie to," but not sharp up. Have the crew aft by the braces and watch for a lull between the squalls, then brace up the after-yards, down helm, bring her to the wind, and set the storm trysail. When heaving a vessel to the men on deck should be protected as much as possible.

Head Reaching.

A vessel is head reaching in bad weather when she has sail set—such as topsails, fore-topmast staysail and mizen staysail, also reefed foresail; she is then making headway through the water, just enough for steerage; frequently, heavy seas break on board over the weather bow.—In this position, and when hove-to, oil can be used to best advantage.

Wear in a Gale.

You have been hove-to under main lower topsail and storm trysail, and your ship is falling off and making bad weather; proceed to wear ship.—First of all, set sail so as to get steerage and headway on the vessel. Set the fore lower topsail, reefed main upper topsail and fore-topmast staysail, and when she falls off, up

helm, and square in the after-yards. When before the wind pay careful attention to the helm, haul round the head-yards, and shift over the fore-topmast staysail sheet; stand by the after-braces, watch for a lull, down helm, brace the yards up and heave her to; take in the main upper topsail and, if necessary, the fore lower topsail.

Squalls.

Heavy weather under reefed topsails, and an ugly squall to windward.—Lower away and furl the upper topsails.

If the squall strikes the ship with great force and throws her on her beam ends, up helm and let go the lee sheets; if the ship does not right herself it may be necessary to cut away the mizen mast.

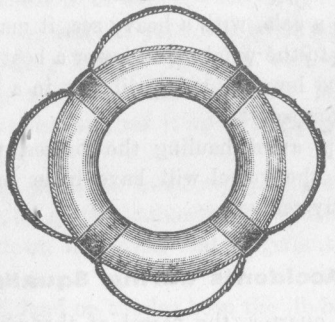
Heavy Weather—Scudding.

To obtain deep sea soundings in stormy weather shorten sail, have the deep sea lead armed, passed forward, and round the lee bow. When all is ready watch for a lull, down helm and heave to; then obtain two good casts.

ACCIDENTS.

When the alarm is given "man overboard," the first order is to throw a life-buoy overboard and get the way off the vessel, then send a man aloft to keep a good look-out and get a boat lowered as soon as possible. It may not be generally known that a man may float in salt water without moving his hands or feet, if he has the presence of mind to throw his head back and his chest forward, thus slightly arching his body.

Fig. 40.



Life-Buoys.

An approved life-buoy is one of solid cork, capable of floating 32 lbs. of iron for 24 hours; the buoy should be fitted with beckets.

An approved life-belt means a belt which does not require to be inflated before use, and which can float 16½ lbs. of iron for 24 hours in fresh water.

Seamen, passengers and emigrants should be exercised in the use of life-buoys and life-belts, so that in the event of an emergency they will be able to make good use of these life-saving appliances.

Man Overboard.

Wind aft, fine weather, throw a life-buoy overboard, down helm, lower the light sails, and as the ship comes to the wind let the

head-yards run forward. Get the lee boat out as soon as possible, and pick the man up. With the after-yards aback and the head-yards full, the ship is hove to, and will not make any headway, but will drift to leeward. In the day-time send a man aloft to direct the boat towards the man in the water.

If braced up under all plain sail throw a life-buoy overboard, steady the helm, lower the royals, and square the after-yards; the ship is now hove to. Get the lee boat out and rescue the man as soon as possible.

If blowing strong, throw a life-buoy overboard. If the vessel is running before a gale, with a heavy sea, it may not be advisable to bring the ship to the wind, or to lower a boat. If hove to, the lee boat might be lowered, using oil, but in a heavy sea the boat is liable to be swamped.

If tacking ship, avast hauling the braces, throw the man a life-buoy, and as the vessel will have little or no headway, he should be promptly rescued.

Accidents during Squalls.

Wind on port quarter, the parral of the main topgallant yard breaks.—Man the halliards and hoist the yard right up. Then send men aloft and rig a temporary parral.

Strong breeze in a squall, the fore-topmast backstay carries away.—Put the helm up, lower away the fore-topgallant sail, upper topsail and jibs; when the vessel gets before the wind, steady the helm, set up the backstays, and when all is secured, set sail.

Fore-yard-arm sprung.—Take in the upper sails and foresail, fish the yard with two spars and lashings, fit on all the gear around all parts, also have a block for the topsail sheets, then set sail.

Fore-yard carried away.—If the yard is completely sprung in the quarter so that it cannot be fished and made fit for use, send it down; also send down the main-yard and send it aloft in place of the fore-yard.

When sending the yard up at sea with the vessel rolling, have a gun-tackle purchase to the forestay, also rolling-tackles from the quarter of the yard to each side of the deck; have the port tackle to the starboard side, and the starboard tackle to the port side.

Truss.—The truss of the main-yard has carried away. Lash the yard to the mast with a good punch chafing mat between, then rig a couple of wire strops round the yard, with iron thimbles in each strop, another piece of wire round the mast with a round turn, the two ends rove through the thimbles, and set up to the after part of the trestle-trees with a watch-tackle purchase, cast off the temporary lashing, and the yard will be in working order.

Trestle-trees settling down.—Have a wire strop made fast to the eye-bolt on the cap, then reeve the bight through the sheave-hole of the mast, and set it up to the eye-bolt on the other side of the cap.

Braced up, your jib-boom weather-guys have carried away.—Hard up the helm, let go the halliards of the head sails, haul them down, also lower down the royals and topgallant sails, and set up new guys.

The wind abeam, land on the lee bow, the jib-boom carries away.—Take in the head sails, royals, topgallant sails, upper topsails, haul the courses up, and bring the ship to the wind; back the after-yards, and heave her to; clear away the wreck forward by getting all on board as soon as possible. Afterwards fill on the after-yards and set sail.

Your jib sheet has carried away in a squall.—Man the down-haul, let go the halliards and haul the sail down.

Braced up, a squall carries away the outer jib and fore top-gallant sail.—Put the helm up, and to help the ship to go off quickly, brail in the spanker, and let go the after stay-sail halliards.

Strong breeze, wind on the port quarter, the weather lower topsail brace carries away.—Put the helm up and bring the wind on the other quarter; then reeve off a new brace.

The weather royal sheet has carried away.—Lower the yard down, clew the sail up, and reeve off another sheet.

The jib downhaul has carried away when taking in the sail.—Keep the vessel off before the wind and send two men out on the boom to haul it down.

In rough weather your lower rigging has become slack.—Swifter it in, fore-and-aft or athwartships, with a spar lashed in the rigging on both sides.

Heavy squall has thrown your vessel on her beam ends.—Up helm, let go the lee sheets, and try to get her off before the wind. If she does not right herself it may be advisable to cut away the mizzen mast. When the weather moderates shift cargo to the weather side and trim her upright.

ANCHORING.

Wind Free.

How would you come to anchor in an open bay, with the wind aft, and moor with 45 fathoms cable?

I would have both anchors all ready for letting go, take the light sails in, and come up to the anchorage under easy canvas, such as upper-topsails, spanker and fore-topmast stay-sail. When the ship is brought into a good position, put the helm down, square the head-yards as she comes head to wind; immediately she gathers sternway let the topsails run down, drop the anchor and slack away the cable as required.

To moor the ship veer out to 90 fathoms, then hold on; when the cable is taut, let go the second anchor and then heave in on the first until there are 45 fathoms on each, having both shackles handy for clearing hawse.

Running Moor.

Reduce all sail to the main upper topsail, and have both anchors ready to let go; when near the anchorage lower away the topsail, and let go the working anchor. The vessel having headway, will drag out the cable; when 90 fathoms are out, hold on the cable and let go the second anchor, and heave in on the first until you have 45 fathoms on each cable.

With a running moor great care must be exercised, because if

the vessel has over much headway she is liable to snap the cable or damage the windlass.

A long heavy vessel will carry much more headway than a small one.

Braced up, Coming to Anchor.

Take in all sail to the fore and main upper topsails. Have both anchors clear and ready to let go. When at the anchorage, down helm, square the head-yards; the vessel being head to wind and the topsails all aback she will gather sternway; drop the working anchor, let the cable run out, and when you have good sternway let the topsails run down. When the cable has run out to 90 fathoms and is taut, drop the second anchor, heave in on the first, and so moor the ship that you have the shackles in good position for clearing hawse.

If you buoy your anchors, the buoy rope is made fast to the crown of the anchor.

Officer's Duty at Anchor Watch.

Attend to the night orders, keep the anchor lights burning brightly, take bearings of shore lights—in the day-time, of land-marks—and see that the vessel does not drive; have the lead-line handy, and drop it over the side, carefully noting the soundings.

If the vessel drags when at single anchor call the master, drop the second anchor, and veer out cable on both anchors.

If it comes on to blow it may be advisable to let go another anchor.

If a cyclone is coming on and your machinery, engines, etc., are in good order, slip your cables and proceed to sea. If the cables are buoyed they can be picked up on returning, or by a mooring-boat.

Tending Ship in a Tide-Way.

In heavy weather a vessel anchored in deep water will ride better with a single anchor and a long scope of cable.

In shallow water, moor with two anchors and veer out to the full length of the cables.

To use Oil.

Before the weather gets over rough make fast a tail-end block to the cable well out ahead, reeve a line through the block, bringing the two ends on board on the forecastle head. Fill the bag with oil, make it fast to the line, and haul it out; the oil will now spread ahead and break the seas as they roll in towards the bow of the vessel. If the vessel is moored have a block and line on both cables and use two oil-bags.

Questions and Answers.

What do you mean by being tide-rode?

When the tide is stronger than the wind.

What do you mean by being wind-rode?

When the wind is stronger than the tide.

If you have the wind and tide ahead, how would you place your ship?

Give her a sheer to port or starboard, and have the cable streaming about one point on the bow.

How would you trim the yards?

In fine weather keep the after-yards pointed to the wind, and the head-yards aback.

Why do you have the fore-yards aback?

Because that will help the vessel to keep her sheer.

If the wind was strong, how would you trim the yards?

Have them all pointed to the wind.

If you are lying with a danger on your starboard side, how would you sheer your ship?

Towards the danger.

Why do you sheer her towards the danger?

Because if she broke her sheer she would go away from the danger.

If she won't keep her sheer, what would you do?

I would steady her with the helm, and set the fore-topmast stay-sail.

When is the helm of no use?

At slack water.

When would you clear hawse?

I would have all ready before the tide finished, and clear at slack water.

Riding at single anchor with 60 fathoms of cable, what would you do at slack water?

Heave short, when the vessel swings and the tide makes, veer out more cable, and steady her with the helm, the anchor streaming about a point on the weather bow.

How will you sheer your vessel with the wind across the tide?

Keep her to leeward with the yards aback, tide a little on the weather bow, anchor well out on the weather bow.

With the wind across the tide, how will the ship swing at slack water?

Head to wind.

What would you do at slack water?

Haul the yards round, when the tide makes, she will be in the same position, viz.:—with the tide a little on the weather bow, and the anchor broad out on the weather bow.

If you are in a steamer at anchor with a strong tide, she continually breaks her sheer, what would you do?

Send a man to the wheel to steer her.

What is a lee-tide?

Tide setting with the wind.

How would you place your vessel with a lee-tide?

Give her a slight sheer with the helm, then she ought to lie steady.

How do ships lie best in a tide-way?

A light vessel to leeward and generally a loaded ship to windward. In deep water a vessel rides best with a long scope of cable, and to leeward of her anchor.

What is the use of an anchor buoy?

It shows the position of the anchor. The starboard buoy should be painted green and the port one red.

Where do you make the buoy-line fast?

To the crown of the anchor.

If you are anchoring in 15 fathoms, what length would you have the buoy-line?

About 16 fathoms.

OIL ON ROUGH SEAS.

The Board of Trade desire to call attention to the following information, which has been published by the Admiralty in their sailing Directions, on the USE OF OIL FOR MODIFYING THE EFFECT OF BREAKING WAVES:—

"Many experiences of late years have shown that the utility of oil for this purpose is undoubted, and the application simple.

"The following may serve for the guidance of Seamen, whose attention is called to the fact that a very small quantity of Oil skilfully applied may prevent much damage both to ships (especially the smaller classes) and to boats, by modifying the action of breaking seas.

"The principal facts as to the use of oil are as follows:—

"1. On free waves, *i.e.*, waves in deep water, the effect is greatest.

"2. In a surf, or waves breaking on a bar, where a mass of liquid is in actual motion in shallow water, the effect of the oil is uncertain, as nothing can prevent the larger waves from breaking under such circumstances; but even here it is of some service.

"3. The heaviest and thickest oils are most effectual. Refined kerosene is of little use; crude petroleum is serviceable when

nothing else is obtainable; but all animal and vegetable oils, such as waste oil from the engines, have great effect.

"4. A small quantity of oil suffices, if applied in such a manner as to spread to windward.

"5. It is useful in a ship or boat, both when running, or lying to, or in wearing.

"6. No experiences are related of its use when hoisting a boat up in a seaway at sea, but it is highly probable that much time and injury to the boat would be saved by its application on such occasions.

"7. In cold water, the oil, being thickened by the lower temperature, and not being able to spread freely, will have its effect much reduced. This will vary with the description of oil used.

"8. The best method of application in a ship at sea appears to be: hanging over the side, in such a manner as to be in the water, small canvas bags, capable of holding from one to two gallons of oil, such bags being pricked with a sail needle to facilitate leakage of the oil.

"The position of these bags should vary with the circumstances. Running before the wind they should be hung on either bow—*e.g.*, from the cathead—and allowed to tow in the water.

"With the wind on the quarter the effect seems to be less than in any other position, as the oil goes astern while the waves come up on the quarter.

"Lying-to, the weather bow and another position farther aft seem the best places from which to hang the bags, with a sufficient length of line to permit them to draw to windward, while the ship drifts.

"9. Crossing a bar with a flood tide, oil poured overboard and allowed to float in ahead of the boat, which would follow with a bag towing astern, would appear to be the best plan. As before remarked, under these circumstances the effect cannot be so much trusted.

"On a bar with the ebb-tide, it would seem to be useless to try oil for the purpose of entering.

"10. For boarding a wreck, it is recommended to pour oil overboard to windward of her before going alongside. The effect in this case must greatly depend upon the set of the current, and the circumstances of the depth of water.

"11. For a boat riding in bad weather from a sea anchor, it is recommended to fasten the bag to an endless line rove through a block on the sea anchor, by which means the oil is diffused well ahead of the boat, and the bag can be readily hauled on board for refilling if necessary.

"12. Towing a vessel in a heavy sea, oil is of the greatest service, and may prevent parting the hawser. Distribute from the towing vessel forward and on both sides; if used only aft the tow alone gets the benefit."

INSTRUMENTS.

THE BAROMETER.

(*See* text book, "Barometer Manual.")

The barometer is an instrument with which to measure the variations in the weight or pressure of the atmosphere. Two kinds are in use for observations at sea, the mercurial and the aneroid. The mercurial barometer consists of a glass tube closed at one end, which is filled with pure mercury, all air being carefully excluded; the tube is then inverted, and its open end immersed in a small cistern, also containing mercury, so as to prevent air entering the tube. Great care is taken to exclude the air, as its presence even in minute quantity will vitiate the readings of the instrument. The pressure of the atmosphere on the surface of the mercury in the cistern maintains the mercury in the tube at a height which corresponds to that pressure, and measurements with the instrument are made by reading the height of the column in the tube above the surface of the mercury in the cistern. British instruments are graduated in inches and decimals of an inch, the average height at the sea level being rather less than 30 inches, though the mercury sometimes rises to nearly 31 inches and falls below 28 inches.

To avoid pumping, owing to the motion of the ship at sea, all marine mercurial barometers have the glass tube very much contracted for the greater part of its length, and are also furnished with an air-trap.

In handling barometers it should be remembered that they are delicate and expensive instruments. The result of rough treatment is breakage; and for scientific purposes, observations with an instrument repaired, and not verified by comparison with an instrument whose error is known, are almost useless.

The barometer should hang where it can swing freely, so as always to take up a truly vertical position. It should be carefully protected from injury, out of the reach of persons passing near it,

and fixed in a convenient place for observing if possible with the light coming from behind the observer, and where it is not liable to considerable changes of temperature, and therefore away from the influence of sunshine or the direct heat of fires or lamps.

The barometer should be set and read at regular intervals every 4 hours, or in doubtful or bad weather more frequently, and the readings entered in the log book.

Wind is air in sensible motion.

The force of a wind accompanying a difference of pressure over two areas is found to be greater as that difference is greater, and it therefore depends not on the mere height of the barometer at the ship, but on the difference between that height and that which subsists over the neighbouring seas. These differences of pressure are spoken of as barometrical gradients; and the standard for their comparison that has been adopted is the difference of pressure, expressed in hundredths of an inch, in 15 miles of distance The greater the difference, the steeper will be the gradient, the closer will be the isobaric lines on a chart representing the pressure, and the stronger will be the winds.

But the direction of the wind is governed by another very distinct influence, which it is important to understand clearly, as it fundamentally affects all classes of wind, and calls for special attention in the case of the most dangerous winds, namely, hurricanes or cyclones.

The air, when apparently wholly at rest, and a complete calm prevails, is in truth moving with great rapidity together with the earth. The velocity of the earth's rotation at the Equator is about 1000 miles per hour from West to East, and it gradually diminishes towards the poles, where it is zero. So long as the air remains at rest (relative to the earth's surface), this movement is not sensible, but it at once becomes effective if the air is impelled to a latitude having either a higher or lower velocity of revolution. In the former case, air possessed of a less velocity from West to East reaches a part of the earth's surface having a higher velocity,

and therefore appears to be impressed with a movement from East to West, or contrary to the earth's direction of revolution, equal to the difference between the two velocities, though the friction against the earth's surface of air passing from one latitude to another soon reduces the initial excess velocity of movement, or makes good the deficiency.

In the Northern Hemisphere, for the reason thus stated, a current of air setting from a lower latitude to a higher gives rise to a south-westerly wind, and a current in the opposite direction to a north-easterly wind. When, therefore, an area of low pressure arises North of the Equator, surrounded by comparatively high pressure, the primary tendency of the air to flow from the outside towards the centre of the area of low pressure will be modified so as to impart a more easterly direction to the wind in the northern half of that area, and a more westerly direction to the wind in its southern half, the joint influence of which will be to set up a circulation round the centre of lowest pressure from West by South, through East and North, round again to the West, *i.e.*, against the motion of the hands of a watch. In the Southern Hemisphere a similar circulation would be established, but in the opposite direction, or with the motion of the hands of a watch. Winds thus circulating round an area of low pressure are spoken of as cyclonic, as they are related in a manner similar to that of the wind of the great storms known as cyclones.

It will readily be seen that, in like manner, air flowing from an area of high pressure to areas of relatively low pressure will in the Northern Hemisphere develop a circulation in the opposite direction to that caused round an area of low pressure, that is, passing from East by South through West and North back to East. Winds thus circulating round an area of high pressure are termed anticyclonic, because they revolve in a direction opposite to that of the cyclonic winds.

What has been termed Buys Ballot's law, it having been first publicly announced in Europe by Professor Buys Ballot, of

Utrecht, is the general statement of the facts thus explained, and it may be thus enunciated:—

In the Northern Hemisphere.	In the Southern Hemisphere.
Stand with your face to the wind, and the barometer will be lower on your right hand than on your left.	Stand with your face to the wind, and the barometer will be lower on your left hand than on your right.

Graduation of Kew Pattern Barometer and its Attached Thermometer.

The latter with graduation in degrees of Fahrenheit added for comparison.

The graduation of thermometers attached to barometers, which are graduated in C.G.S. units, is usually in Centigrade degrees from the Absolute zero of temperature, which is 273° Centigrade below the freezing point of water or 459° on the Fahrenheit scale. The zero represents, so far as our knowledge goes, the temperature at which the whole of the heat of any substance whatever would be converted into some other form of energy.

The principal advantages of the Absolute scale for meteorological work is that all negative values are avoided, and all calculations of the pressure and density of air are reduced to simple proportions.

The Kew pattern barometer is graduated in inches and to the five thousandth part of the inch, and they are also graduated in millibars and tenths, the millibar being approximately one thousandth part of the ordinary atmospheric pressure at sea level.

Here it will be well to remember a few facts connected with the barometer.

Normal pressure for the British Isles—
29·92 mercury inches=1013·2 millibars.
Highest recorded pressure for the British Isles—
31·11 mercury inches=1053·5 millibars.

Lowest recorded pressure for the British Isles—
27·33 mercury inches=925·5 millibars.
and that 1 millibar =·029 mercury inch.

Barometers of the Kew pattern with fixed cisterns are affected by an error called the error of capacity, and this is because the level of the mercury in the cistern varies as the height of mercury in the tube is higher or lower. The graduations on the scale are adjusted so that no correction need be made. Another error, called the error of capillarity, caused by the friction between the mercury and the glass tube and which depresses the column of mercury, is also allowed for in the graduations therefore no correction has to be made.

Before comparisons with other compensated readings are made, various compensations must be worked out and applied to readings. They are for latitude, height above sea level, and temperature, and possibly index error.

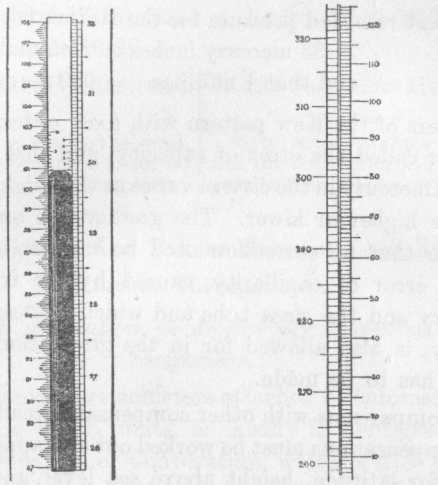
Barometers are certified to read correctly at a certain temperature (marked on the instrument) in Latitude 45° at sea level. This temperature is called "Standard."

The latitude correction is necessary because of the earth's shape; the polar diameter being less than that at the Equator, gravity in the higher latitudes is greater than at the lower. This means that mercury in the higher latitudes is heavier and does not rise so high in the tube as it does in lower latitudes at the same atmospheric pressure.

The correction for altitude is necessary because height above sea level means a lower pressure on the mercury in the cistern.

Temperature changes affect the mercury, causing it to increase in volume at higher temperatures and *vice versa*.

For a full description of these compensations and how they are applied it is advisable to study the *Barometer Manual*, which gives a very full explanation of them and also contains much useful information on many other navigational instruments.

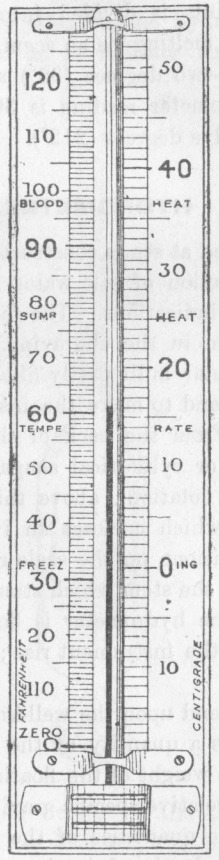


Centibars and Millibars. Inches, Tenths and Twentieths. Temperature in Centigrade Degrees from Absolute Zero. Temperature. Fahrenheit.

THERMOMETER.

This instrument measures temperature but is not sensibly affected by changes of the pressure of the air. It consists of a glass tube of very small bore, closed at one end, and united at the other to a bulb, which is commonly filled with mercury. Almost all substances expand when they are heated, and contract when they are cooled, but they do not all expand equally. Mercury expands more than glass, and so when the thermometer is heated the mercury in the bulb expands, and that portion of it which can no longer be contained in the bulb rises in the tube, in the form of a thin thread. The tube being very minute, a small expansion of the mercury in the bulb, which it would be difficult to measure directly, becomes readily perceived as a thread of considerable length in the tube. When the instrument is cooled the mercury shrinks, and the thin thread becomes shorter as the mercury subsides towards the bulb. By observing the length of

the thread of mercury in the tube, as measured by the graduation on the scale at its side, or marked on the tube, the thermometer shows the temperature of the bulb at the time, which thus



indicates the temperature of the surrounding air, or of any liquid in which the bulb is immersed.

The indications of a thermometer are recorded in degrees, the

scale for which is obtained as follows. There are two fixed points on the scale according to which thermometers are graduated, viz., that at which ice melts, and that at which water boils. In the thermometers in ordinary use in Great Britain, the distance between these two points is divided into 180 parts, or degrees. When surrounded by melting ice an accurate thermometer on this scale indicates thirty-two degrees (32°) and if placed in boiling water, when the barometer reading is 30 inches, the reading is two hundred and twelve degrees (212°).

HYDROMETER.

The hydrometer used at sea is constructed of glass. If made of brass, the corrosive action of salt water soon renders the instrument erroneous in its indications. The form of the instrument in common use is shown in the engraving. It consists of a glass tube ending in a globular bulb partly filled with mercury or small shot, to act as ballast and to make the instrument float steadily in a vertical position. From the neck of the bulb the glass is expanded into an oval or cylindrical shape, to give the instrument sufficient volume for flotation; above this it is tapered off to a narrow upright stem which encloses an ivory scale, and is closed at the top. The divisions on the scale read downwards, so as to measure the length of the stem which stands above the surface of any fluid in which the hydrometer is floated. The denser the fluid, the higher will the instrument rise; the rarer the fluid, the lower it will sink.

The indications depend upon the well-known principle, that any floating body displaces a quantity of the fluid which sustains it, equal in weight to the weight of the floating body itself. According, therefore, as the relative specific gravities of fluids differ from each other, so will the quantities of the fluids displaced by any floating body, or the depth of its immersion, vary, when it is floated successively in each.

The specific gravity of distilled water, or its relative weight compared, at the temperature of 59 ° F., to an equal volume of

other substances, being taken as unity, the depth at which the instrument remains at rest when floating in distilled water is the zero of the scale on which its indications are recorded. If the specific gravity, or the density of the water be increased, as it is by the presence of salt in solution, the hydrometer will rise, and the scale is so prepared as to indicate successive increases of

density up to 4 per cent., or 40 in the thousand parts. The graduations thus extend from 0 to 40; the latter corresponding to the mark on the scale which will be level with the surface when the instrument is placed in water, the specific gravity of which is 1·040. In recording observations, the last two figures only—being the figures on the scale—are written down.

HYDROMETER.

With the hydrometer is found the draught which a ship should be loaded in fresh water of any density, so as to have a given draught in sea water.

The average density of sea water is 1025 ounces to the cubic foot.

For the other two terms we require the density of the dock water in which the vessel is loading, and the draught of the vessel in sea water.

Worked Example.

Required the draught to which a vessel can be loaded in a harbour where the density of the water is 1010 ounces, so that the vessel may float at a draught of 20 feet in sea water.

Density of sea water = 1025
Draught of vessel = 20 ×

Density of harbour water 1010 ÷) 20500 (20 feet
2020

300
12 ×

1010 ÷) 3600 (3·5 inches.
3030

570·0
5050

650

Ans.—The vessel must be loaded to draw 20 feet 3½ inches in the harbour.

Worked Example.

If your vessel draws, when loaded, 22 feet in sea water, the density of sea water = 1025 ounces. The density of the dock water in which you are loading was found by the hydrometer to be 1005 ounces. Find the draught to which your ship can be loaded.

Sea water = 1025
Draught in sea water × 22 feet.

2050
2050

Dock water = 1005 ÷) 22550 (22 feet.
2010

2450
2010

440
× 12

Dock water = 1005 ÷) 5280 (5·2 inches.
5025

255·0
2010

540

Ans. 22 ft. 5 ins. in dock water.

The difference in this case is 5·2 inches when your ship passes from the dock to sea water.

Examples for Practice.

(1) Required the draught to which a vessel can be loaded in a dock where the density of the water is 1009 ounces, so that the vessel may float at a draught of 21 feet in sea water.

Ans. 21 feet 4 inches.

Another method of working out problems connected with hydrometers and draught is necessary when the allowance for the difference between the fresh and salt water marks is given.

In this case, multiply the fresh water allowance by the difference between the salt water density and given density, and divide by the difference between salt and fresh water densities. The result is the required allowance.

Example:—A vessel is allowed to load 6 inches deeper in fresh than in salt water. What will she be allowed in water, the density of which is 1015, the density of salt water being 1025 ounces per cubic foot?

Salt water density	1025	- - - -	1025
Fresh ,,	1000	Given density	1015
difference	25	difference	10

$25 : 10 :: 6 : x$

10
6

25)60(2·4 inches allowance
50

100
100

Example:—If the fresh water allowance is 5·5 inches, what would be the allowance in water of 1018 ounces to the cubic foot?

Salt water density	1025	- - - -	1025
Fresh ,,	1000	Given density	1018
difference	25	difference	7

$\not{2}\not{5} : 7 :: \not{5}\cdot\not{5} : x \quad \frac{7\cdot7}{5} = 1\cdot54$ inches allowance.
5 1·1

Converting Thermometer Readings.

To convert one thermometer reading into that of another proceed as follows:—

	Fahrenheit	Centigrade	Absolute	Reamur
Boiling point -	212°	100°	373a	80°
Freezing point -	32°	0°	273a	0°
	180	100	100	80
Divide by 20 =	9	5	5	4

These are the numbers to be used.

To convert Fahr. into Cent., subtract 32° from the Fahr. reading, multiply by 5 and divide by 9.

What temp. Cent. is 50° Fahr.?

50° Fahr.
−32
18
5
9)90
10 Cent.

To convert Fahr. into Reamur, subtract 32° from the Fahr reading, multiply by 4 and divide by 9.

What temp. Reamur is 50° Fahr.?

50° Fahr.
−32
18
4
9)72
8° Reamur.

To convert 25° Cent. into Fahr., multiply by 9, divide by 5 and add 32°.

25° Cent.
9
5)225
45
+32
77° Fahr.

When a reading is given below zero, be careful with the algebraic signs.

Convert −4° Cent. into Fahr.

−4° Cent.
9
5)−36
−7·2
add 32
25·2 Fahr.

Convert −20° Reamur into Fahr.

−20° Reamur.
9
4)−180
−45
+32
−13 Fahr.

To convert Absolute into Centigrade subtract 273°
To convert Centigrade into Absolute add 273°.

THE ANEROID BAROMETER.

The aneroid barometer consists of a thin corrugated elastic metal drum, which is partially exhausted of air. Fastened to the surface of the drum is a spring which prevents the drum collapsing. Connected to this spring is a rod which leads to a system of levers, which connect to a small fine chain wound round the spindle of the pointer. Attached to this spindle is a hair spring; this acts against the chain and keeps it taut. The aneroid barometer depends for its indications on the pressure of the atmosphere moving the top of the drum, and this movement being transmitted by the mechanism to the pointer. Attached to the spring, on the face of the drum, is a pinion which is visible at the back of the instrument, and terminating in a screw head. This can be turned either way to increase or decrease the pressure of the spring and thus the error of the barometer may be corrected.

The advantage of using an aneroid is that it can be more conveniently placed in a small chartroom, where it would not be desirable to hang a mercury barometer; also it shows a change of atmospheric pressure more rapidly.

At the same time it is not so reliable, as its mechanism is liable to get out of order. Readings of the aneroid barometer only require to be corrected for height above sea level and index error, not for temperature or latitude. The dial is marked to inches and tenths. In many it is marked to hundredths. More modern instruments may be marked to millibars and the decimal part of a millibar.

THE SEXTANT.

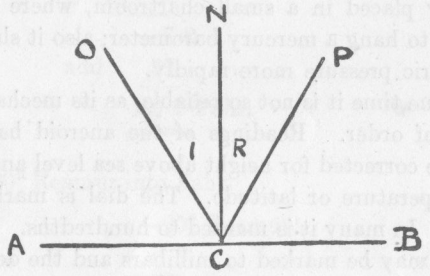
The sextant is an instrument of double reflection used for measuring angles, and derives its name from the extent of its limb, *i.e.* 60° (the sixth part of a circle). Being an instrument of double reflection, the arc is divided into twice as many degrees as are contained in the arc.

Practically all sextant limbs are made greater than 60° in extent and it is common to be able to read to 3° or 4° to the right of the zero mark; this is called the arc of excess and is very valuable to an observer taking "on and off the arc" altitudes.

It is necessary also to have a sextant marked up to at least 139° 50′ so as to read correctly an angle up to 120°, this being necessary, because the extent of the arc commonly covered by the vernier is 19° 50′.

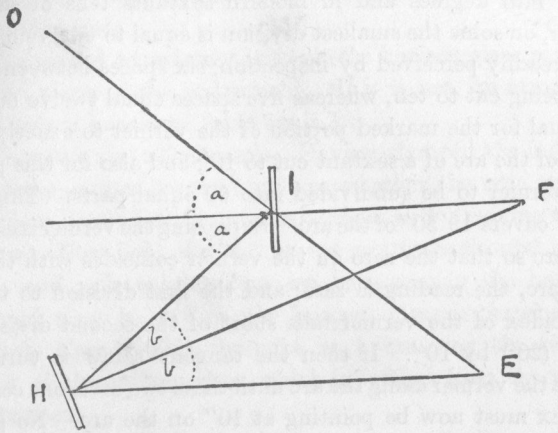
The construction of the sextant is based upon two optical principles: (1) The angle of incidence is equal to the angle of reflection; (2) if any ray of light is twice reflected in the same plane, by two plane mirrors, the angle between the first ray and the twice reflected ray is double the angle between the reflecting surfaces.

Proof of Principles.



In above figure—

A C B=Reflecting surface.
C N =Normal.
O =Celestial object.
O C =Direct ray of light.
C P =Reflected ray of light.
Angle *O C N*=Angle of incidence (*I*).
Angle *P C N* =Angle of reflection (*R*).



In figure above—

O =Celestial object.
I =Index glass.
H =Horizon glass.
O I =Direct ray of light.
I H =Reflected ray of light.
H E =Twice reflected ray of light.

I F and *H F* are drawn normal to the planes of the mirrors, thus the angle (*H F I*) between them is equal to the angle between the planes of the mirrors produced.

To prove that the angle *O E H* (the angle between the first ray and the twice reflected ray) is double the angle *H F I* (the angle between the mirrors)—

$2a-2b=E$ and $a-b=F$, multiply by $2=2a-2b=2F$, therefore $E=2F$.

The vernier (named after the inventor, Pierre Vernier, A.D. 1631) is a small auxiliary scale, fitted to the index bar so that it is in close contact with the arc, and used for the purpose of obtaining subdivisions of the arc. The arc of the sextant is

divided into degrees and in modern sextants tens of minutes, however, on some the smallest division is equal to twelve minutes; This is readily perceived by inspection; six spaces between degree marks being cut to ten, whereas five spaces equal twelve minutes. It is usual for the marked portion of the vernier to exactly cover 19° 50′ of the arc of a sextant cut to 10′; and also for this portion of the vernier to be subdivided into 60 equal parts. Thus each division covers 19′ 50″ of the arc. Supposing the vernier is clamped to the arc so that the zero on the vernier coincides with the zero on the arc, the reading is zero; and the first division to the left of the index of the vernier falls short of the second division on the arc (20′) by 10″. If then the tangent screw is turned to advance the vernier along the arc until these two divisions coincide, the index must now be pointing at 10″ on the arc. No greater precision than this can be obtained.

This degree of accuracy can be readily obtained by dividing the value of one scale division by the number of divisions on the vernier. *E.g.* one scale division = 10′, divided by 60; *i.e.* the number of vernier divisions gives 10″ as the result.

The instrument is used for measuring angles both vertical and horizontal, the former comprising altitudes of heavenly bodies, angles of lighthouses, points of land, etc., the latter comprising the angles observed between lights, points of land, beacons, etc., when being used in connection with the station pointer to fix the ship's position.

Adjustments of the Sextant.

The first adjustment of the sextant is to set the index glass perpendicular to the plane of the instrument. If it is not, an error exists known as the "error of perpendicularity."

To make the adjustment:—Clamp the vernier about the middle of the arc, hold the instrument face up and arc away from you, look obliquely into the index glass so as to see the arc and its reflection. If they are in one line the glass is perpendicular, but

if not, they are brought so by moving the screw at the back of the index glass.

The second adjustment is to set the horizon glass perpendicular to the plane of the instrument. If it is not, an error is caused, and this is known as "side error."

To make the adjustment:—Having clamped the index at zero, hold the sextant vertical and see whether the true and reflected horizons are in line; if not, make them so by moving the tangent screw. Now hold the instrument nearly horizontal so that the true and reflected horizons are both seen in the horizon glass. Should they be in line the horizon glass is perpendicular, but if not, they can be brought so by moving the screw at the back of the horizon glass, which is further from the plane of the instrument.

At night:—Hold the instrument vertically, look through the telescope and horizon glass at some heavenly body and move the index towards and away from the zero of the scale. Should the reflected image pass exactly over the true image no side error exists, but if it does not the same screw must be turned until it does.

The horizon glass must be parallel to the index glass when the index is clamped at zero; if not, index error exists.

To make the adjustment:—Clamp the index at zero, hold the instrument vertically and look through the horizon glass at the horizon. If the true and reflected horizons are in line, the horizon glass is parallel to the index glass, but if not, they must be brought in line by moving the screw, near the plane of the instrument, at the back of the horizon glass. At night, this adjustment may be made by looking through the telescope and horizon glass at a star, the index being clamped at zero. Should the true and reflected stars coincide no error exists, but if separated they can be brought into coincidence by the above-mentioned screw.

It should be understood that the pressure exerted on the screw

invariably puts out the other adjustment and these two should be taken out together.

In the absence of the third adjusting screw, the index error must be found and applied.

The axis of the telescope must be parallel to the plane of the instrument; if not, the error of collimation exists.

To make the adjustment:—Screw the inverting telescope into the telescope collar, focus it, and turn the eyepiece round until two of the wires in it are parallel to the plane of the instrument. Select two well defined celestial objects, not less than 90° apart, and bring them into exact contact on the wire nearest the plane of the instrument. Now, move the sextant slightly and bring them on to the other wire; if they remain in contact the adjustment is correct; if not, they must be brought in contact by the two screws in the telescope collar.

Should the objects appear to separate, on the wire furthest from the plane of the instrument, the object end of the telescope is drooping towards the plane of the instrument and *vice versa*. When the adjustment is perfectly made the two images overlap when moved to the centre of the square made by the four wires.

Correcting the Index Error.

By the horizon:—Clamp the index at zero, hold the instrument vertically and look through the horizon glass at the horizon. If the true and reflected horizons are in one line, there is no index error; if not, turn the tangent screw until they are in line. The reading is the index error, to be *added* if *off* the arc, but to be *subtracted* if *on* the arc.

By a star.—Clamp the index at zero, hold the instrument vertically and look through the telescope and horizon glass at a star. If the true and reflected stars coincide, no index error exists; should the true be above or below the reflection, turn the tangent screw to bring them into coincidence. The reading is the index error; *add* if *off*, but *subtract* if *on* the arc.

By the sun:—Clamp the index about 32′ on the arc. Hold the instrument vertically and look through the telescope and horizon glass at the sun (do not forget the shades). Two suns are seen, the reflected below the true; bring their limbs in exact contact by means of the tangent screw, read off and mark it down. Next clamp the index about 32′ off the arc; again bring the limbs of the true and reflected suns in contact, read off and mark it down. Subtract the lesser reading from the greater and divide the difference by 2; the result is the index error, to be *added* when the greater reading is *off* the arc, but to be *subtracted* when the greater reading is *on* the arc.

Examples:—	36′ off	31′ off
	30 on	34 on
	—	—
	2) 6	2) 3
	—	—
	3′ to be added.	1·5 to subtract.

The proof of the readings being correct, is that a fourth of the sum of the readings should equal the semi-diameter of the sun. Look in the *Nautical Almanac* for the semi-diameter of the sun for the day; if they coincide your readings are correct.

Example:—	36′ off	31′ off
	30 on	34 on
	—	—
	4)66	4)65
	—	—
Semi-dia.	16·5	Semi-dia. 16·25

In very extreme cases, when a sextant is very much out of adjustment, it might be possible to get the suns in contact when they are both on or both off the arc. It is not likely, but should it be so half their sum is the index error, to be subtracted when on, but to be added when off the arc.

The proof of the readings being obtained by taking one-fourth of their difference and this should equal the sun's semi-diameter for the day.

Example:—72′ on the arc	72′
8′ on the arc	8′
—	—
2)80	4)64
—	—
40′ index error to subt.	16′ sun's semi-dia.

Besides the errors already described, sextants are liable to many other mechanical errors, amongst which may be mentioned centering error, graduation, faulty shades and mirrors.

Centering error is caused by the pivot around which the index bar revolves not being in the centre of the circle of which the arc forms part.

If the faces of the shades or mirrors are not ground perfectly parallel they will cause an error.

When the zero of the vernier coincides with any division on the arc, the 10′ mark of the vernier should also coincide with a division. Should it not do so graduation error exists.

All the glasses should be in good order and the instrument perfectly centred.

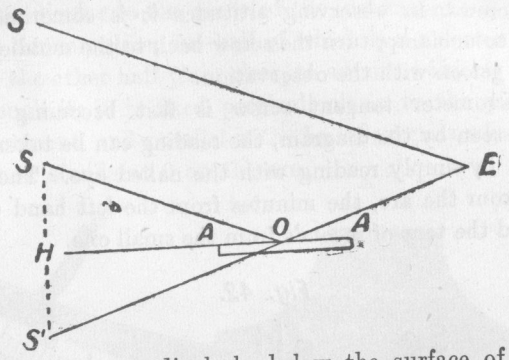
Note.—Sextants can be tested at Kew for a small fee.

Artificial horizon is a reflector whose surface is perfectly horizontal. It is used to observe the altitudes of celestial objects on shore or at sea when the horizon is obscured.

Let *A A* represent a level surface of mercury, *E* the eye of an observer, *S* the real sun whose altitude is to be taken. The angle *S E S′* is found by bringing the image of the sun reflected by the index glass in contact with its image reflected by the mercury, as observed through the horizon glass. (*See* fig. 41.)

The angle *S E S′* = *S O S′* = twice *S O H*—the object's true altitude.

Fig. 41.



S′ is as far perpendicularly below the surface of the plane horizontal mirror *A A*, as the object *S* is above it.

To the altitude taken with the artificial horizon, the index error of the instrument must be applied, and one-half the result must be used as the observed altitude.

No correction for dip is required.

Sextant, with Index to its Different Parts.

By the courtesy of Messrs. Heath & Co., New Eltham, London, S.E.9, we are able to produce these illustrations.

First diagram:—A sextant with the old-fashioned spring tangent screw, vernier and microscope.

Second diagram:—The "Hezzanith" rapid-reader micrometer tangent screw.

Third diagram:—The back view of the "Hezzanith" Semper Paratus endless tangent screw.

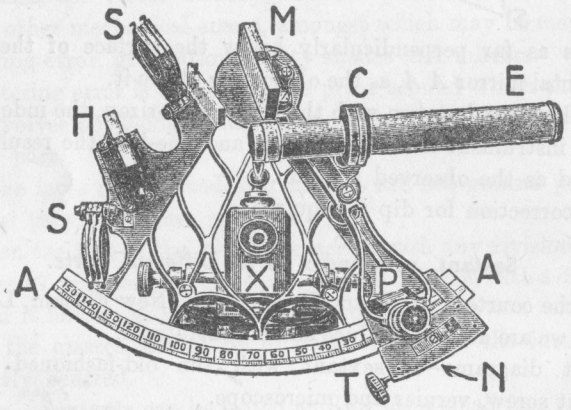
The advantage of these endless tangent screws, as their names imply, is that the index bar can be moved from one end of the arc to the other by simply turning the screw.

With the old style of spring tangent screw and clamp screw, the index bar must first be clamped to the arc by means of the clamp screw, then it will be found that the vernier can only be

moved a certain distance along the arc., *i.e.* to the limit of the tangent screw. In observing altitudes it is sometimes found necessary to unclamp, turn the screw back to the middle position and again get on with the observation.

The micrometer tangent screw is fast becoming popular. As will be seen by the diagram, the reading can be taken to tens of seconds by simply reading with the naked eye. The degrees are read from the arc, the minutes from the left hand (or large reader) and the tens of seconds from the small one.

Fig. 42.



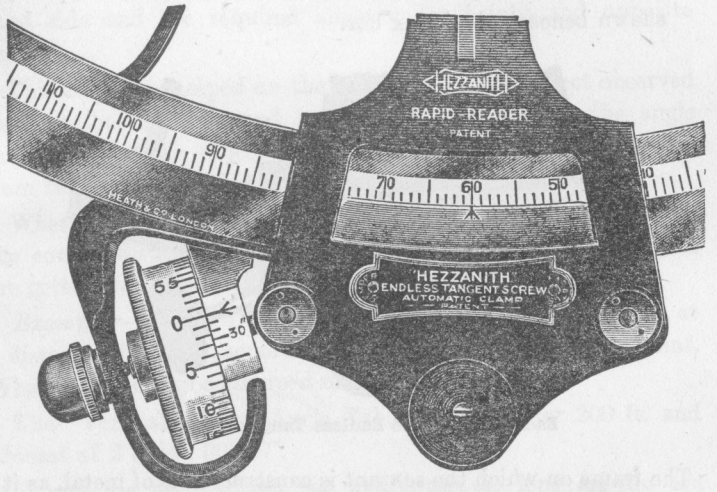
A A′ is the arc (or limb) graduated from right to left, from 0 to 120° or 150°—subdivided by 10′, 15′ or 20′, according to the size and perfection of the instrument. The best instrument reads to 10″. To the right of 0 is a small space of graduation called the arc of excess.

M N is the radius or index bar, movable along the arc and having a dividing scale *N*, called the vernier.

M is the index glass, a reflector or mirror, which moves with the index bar, and is fixed on it in such a manner that its plane

is always over the centre of motion of the index, and perpendicular to the plane of the instrument.

H is the horizon glass, one-half of which is a reflector or mirror, and the other half plain glass, to admit of objects being seen through it; it is fixed perpendicularly to the plane of the instrument, and parallel with the index glass when 0 on the vernier stands at 0 on the arc.



Micrometer Tangent Screw.

S are the index shades of coloured glass, to be turned down between the index glass and the object glass, as the eyesight requires, in order to moderate the brightness of an object—as the sun or moon.

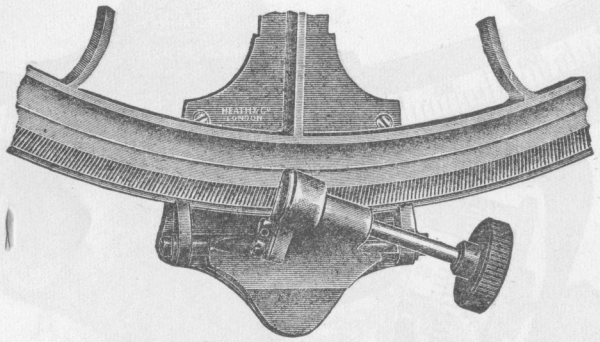
S′ are the horizon shades of coloured glass to be turned up, as required, beyond the transparent part of the horizon glass.

E is the telescope to be screwed into the collar *C*, which is a double ring; when the telescope is absent, the collar is the place of the sight vane.

P is the microscope, movable, for reading accurately the divisions of the arc and vernier.

T is a tangent screw for giving a small motion to the index after it has been partially fixed with a clamping screw, which is at the back of the lower end of the index bar and under the vernier.

X—The handle of the sextant, by which it can be held in any position between the vertical and horizontal, is partly shown beneath the index bar.



Back View of the Endless Tangent Screw.

The frame on which the sextant is constructed is of metal, as it should be for the production of an accurate instrument.

The sextant derives its name from the extent of its limb, which is the sixth part of a circle, or 60°, but being an instrument of double reflection, it is divided into 120°. It is used for measuring angles, as the altitudes of and distance between heavenly bodies, and also altitudes of and angles between terrestrial objects.

Danger Angles, and Their Use.

There are two kinds of danger angles used in navigation: (1) Vertical danger angles; (2) horizontal danger angles.

A knowledge of danger angles is of the utmost value as by them a ship can be safely and confidently navigated past hidden dangers.

Suppose it is required to pass at a distance of 2 miles from a lighthouse or headland, of which the height is known. Turn to the table in "Norie's" headed "Distance by Vertical Angle," pages 175 to 180. You will find the height of the object in feet at the top of the page, the distance in miles and cables at the left hand side and the required angle under height and opposite distance.

This angle is clamped on the sextant, and the object observed through the telescope and horizon glass; so long as the angle subtended by the object remains smaller than the one taken from the tables, the ship is outside the required distance.

When the angle subtended is the same as in the table you are the correct distance off, but should the angle become larger you are getting too close and the ship must be hauled out.

Example:—Required to pass a lighthouse, 200 feet in height, at a distance of 2 miles, so as to clear a hidden danger off the point. What angle must be clamped on the sextant?

The "Vertical Danger Angle Table" gives, under 200 ft. and abreast of 2 miles, 00° 57′.

If you are approaching the lighthouse, so long as you are outside the 2-mile radius, the observed angle will be less than 57′: should you find the observed angle becoming larger than 57′, haul out until the angle is that required. Thus you may pass along the arc of a circle, keeping the correct distance off until you are clear of all danger and you find the angle subtended becoming smaller as you recede from the lighthouse.

A short and easy method of finding the required angle, without the use of tables, is to multiply the height of the lighthouse, in feet, by the factor ·565 and divide by the distance you wish to pass off it. The result will be the required angle, in minutes.

Same example, worked with this method.

Height of lighthouse	200 feet
Factor	·565
Distance required in miles	2)113·000
Required angle, in minutes	56·5′

Again, required to pass a distance of 1·5 miles off a lighthouse 145 feet in height. What angle will you have to clamp on the sextant?

The "Vertical Danger Angle Table" gives 00° 55′.

Alternative method—

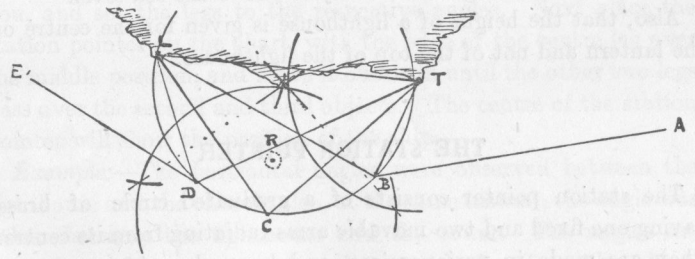
Height of lighthouse	145 feet
Factor	·565
	725
	870
	725
	1·5)81·925(54·62
	75
Angle in minutes 54·62	69
or 54′ 37″	60
	92
	90
	25
	30

You cannot clamp 37″ on your sextant as it will only read to 10″ so clamp it to 54′ 40″.

It is as well to notice, from the above example, the distance from a lighthouse or headland can be obtained by multiplying the height of the object in feet by ·565 and dividing by the observed angle in minutes, the result being in miles.

Height of object	200 feet
Factor	·565
Observed angle	57′)113·000(1·98 miles
	51
	560
	513
	470
	456

In using horizontal danger angles, it is necessary to have two well defined objects, such as lighthouses, headlands, towers, etc., that are marked upon the chart and which are distinct enough to be picked up with the sextant. At night it is necessary to use two lights.



For example:—Suppose *L* to represent a lighthouse. *T* a tower, and *R* a submerged rock some distance off shore. It is required to pass at a distance of 1 mile off the danger, the course being from *A* to *E*.

Take 1 mile as radius and with your compasses describe a circle round R. Choose a point (c) about equidistant from L and T. Join C to L and C to T. The angle $L\,C\,T$ is the horizontal danger angle. (Measure it with a protractor.) If we bisect the lines $C\,T$ and $C\,L$ and draw perpendiculars (as shown in figure) their point of intersection is the centre of a circle passing through L, T and C.

Suppose the vessel in proceeding from A to E arrives at B, the angle between the objects will be on the sextant. Should you enter the circle the angle will become greater and you will know you are getting too close. The ship is hauled out until the angle comes on again. By keeping the angle on, the ship will be kept along the danger circle, until her course towards E decreases the angle and the danger is known to be passed.

The angles $L\,B\,T$, $L\,C\,T$ and $L\,D\,T$ are equal. Angles subtended by a chord ($L\,T$) in the same segment of a circle are all equal.

It should be remembered that all heights given on the charts are given above high water of spring tides and so, when there is a large rise and fall of tide, it may be necessary to make an allowance for the height of the object above the sea level.

Also, that the height of a lighthouse is given for the centre of the lantern and not of the top of the lighthouse.

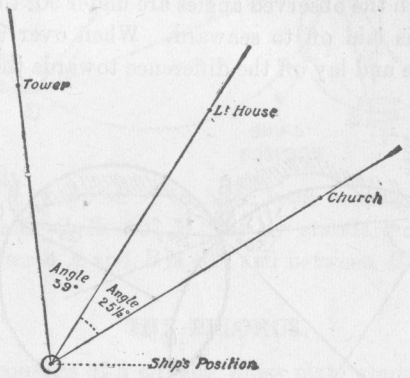
THE STATION POINTER

The station pointer consists of a graduated circle of brass having one fixed and two movable arms radiating from its centre. They are made in various sizes, and have clamping screws to set the movable legs to any required angle. First-class instruments, like the sextant, are fitted with tangent screws, etc.

It is a simple instrument to understand, and is used to lay off horizontal angles on the chart to fix a ship's position.

How to Use the Station Pointer, and Observe Horizontal Angles

Select three suitable objects which are on the chart. Measure with the sextant the horizontal angle between the first two objects, and at the same time have another officer to measure the horizontal angle between the second and third object. Read off

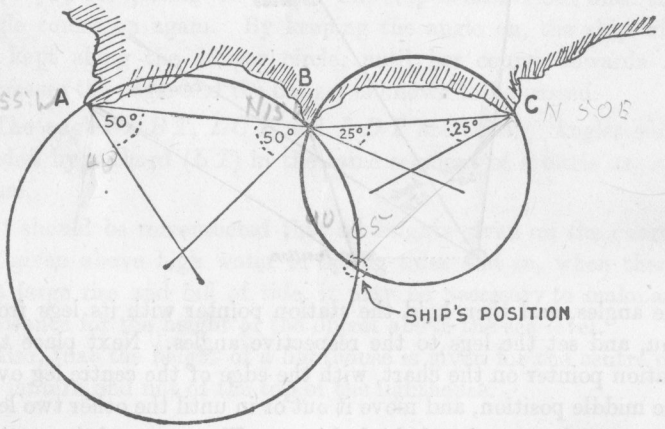


the angles, and then hold the station pointer with its legs from you, and set the legs to the respective angles. Next place the station pointer on the chart, with the edge of the centre leg over the middle position, and move it out or in until the other two legs pass over the second and third objects. The centre of the station pointer will show the position of the ship.

Example:—The horizontal angles were observed between the lighthouse and the church; also, at the same instant, the angle was taken between the lighthouse and the tower. The angles are now clamped on the station pointer, and placed on the chart, with the feathered edge of the centre leg on the lighthouse; now move the instrument until the others pass over the church and tower, as shown in the diagram. The centre of the instrument will show the exact position of the ship on the chart.

In the event of not possessing a station pointer the position of the ship may be found as follows: Connect the three objects by straight lines and from both ends of each line lay off the complement of the angle between the objects. The points where these angular lines intersect will be the centres of the circles passing through the objects and the ship. Where the two circles intersect is the ship's position.

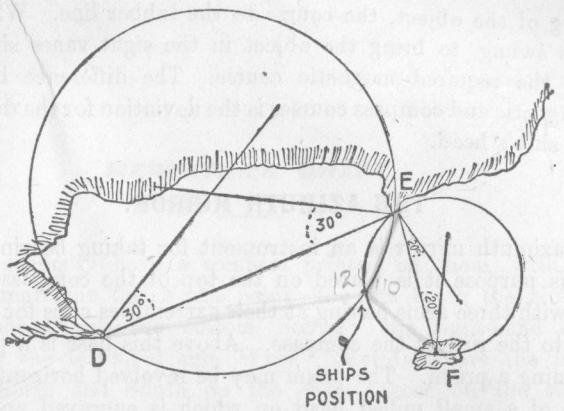
Note.—When the observed angles are under 90° the complement of the angle is laid off to seaward. When over 90°, reject 90° from the angle and lay off the difference towards the land.



Example 1.—The angle between *A* and *B* is 40° and between *B* and *C* is 65° (usually expressed by *A* 40° *B* 65° *C*. Required the ship's position.

Example 2.—The angle between *D* and *E* is 120° and between *E* and *F* 110° (or *D* 120° *E* 110° *F*). Required the position of the ship.

It may be observed that the angles may be taken by the compass instead of by the sextant. It is only necessary to take the difference between the bearings and consider them as angles.



For example, suppose *A* to have been bearing N. 55° W., *B* N. 15° W., and *C* N. 50° E., all by standard compass. The difference between *A* and *B* is 40°, and between *B* and *C* 65°.

THE PELORUS.

A pelorus consists of a circular brass plate graduated the same as a compass card. It is fitted with sight vanes, reflecting glass and coloured shades. Both the sight vanes and the card can be clamped independently of each other. The plate rests upon another circular brass plate on which a lubber line is cut.

It is used for various purposes amongst which may be mentioned taking bearings of objects which are impossible to observe by the standard compass, they being shut out by some of the superstructure of the ship; or bringing the ship's head to some magnetic course by means of an object of which the magnetic bearing is known.

In the first case it is essential that the pelorus should be clamped to the course by compass, and at the time of taking the bearing the ship must be heading on that course.

In the second case, the sight vanes must be clamped to the

bearing of the object, the course to the lubber line. When the ship is swung, to bring the object in the sight vanes she must be on the required magnetic course. The difference between the magnetic and compass courses is the deviation for the direction of the ship's head.

THE AZIMUTH MIRROR.

An azimuth mirror is an instrument for taking bearings; and for this purpose it is placed on the top of the compass. It is made with three arms having at their extremities clips for attaching it to the ring of the compass. Above this base is a pedestal containing a prism. The prism may be revolved horizontally by means of a small milled head on which is engraved an arrow. Coloured shades are fitted as on a sextant to guard the eyes against strong sunlight. A pointer is also fitted close on to the glass cover of the compass.

When taking bearings of heavenly bodies it is usual to have the arrow point up, but when objects are on or near the horizon it is used point down.

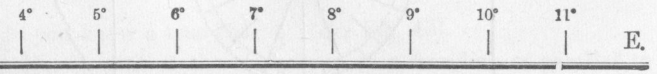
Should the prism not be correctly placed an error will be caused. This can be determined by using the prism arrow up and then arrow down; if the bearings coincide there is no error. Should the bearings be different the error may be eliminated by means of the small securing screws.

MERCATOR'S CHART.

Charts generally have a compass printed on them, with an arrow to represent the North point; the top being the NORTH part of the Chart, the bottom SOUTH; the right-hand side EAST, and the left-hand side WEST. Meridians are the lines running North and South on the chart—those on the sides, which are divided into degrees and miles, are called Graduated Meridians. Parallels of Latitude are the lines running East and West—those at the top and bottom are divided into degrees and miles, and are called Graduated Parallels. Latitude is measured at the sides on the Graduated Meridians. Longitude is measured at the top and bottom on the Graduated Parallels.

To know a True Chart, the North point of the compass is on a Meridian or parallel to a Meridian. A Magnetic Chart has the North point of the compass to the East or West of the True North—the difference between a Magnetic and True Chart is the Variation. On a chart for the Northern Hemisphere, the degrees of Latitude increase upwards; for the Southern Hemisphere, the degrees of Latitude increase downwards. East Longitude increases to the right, and West Longitude increases towards the left side of the Chart.

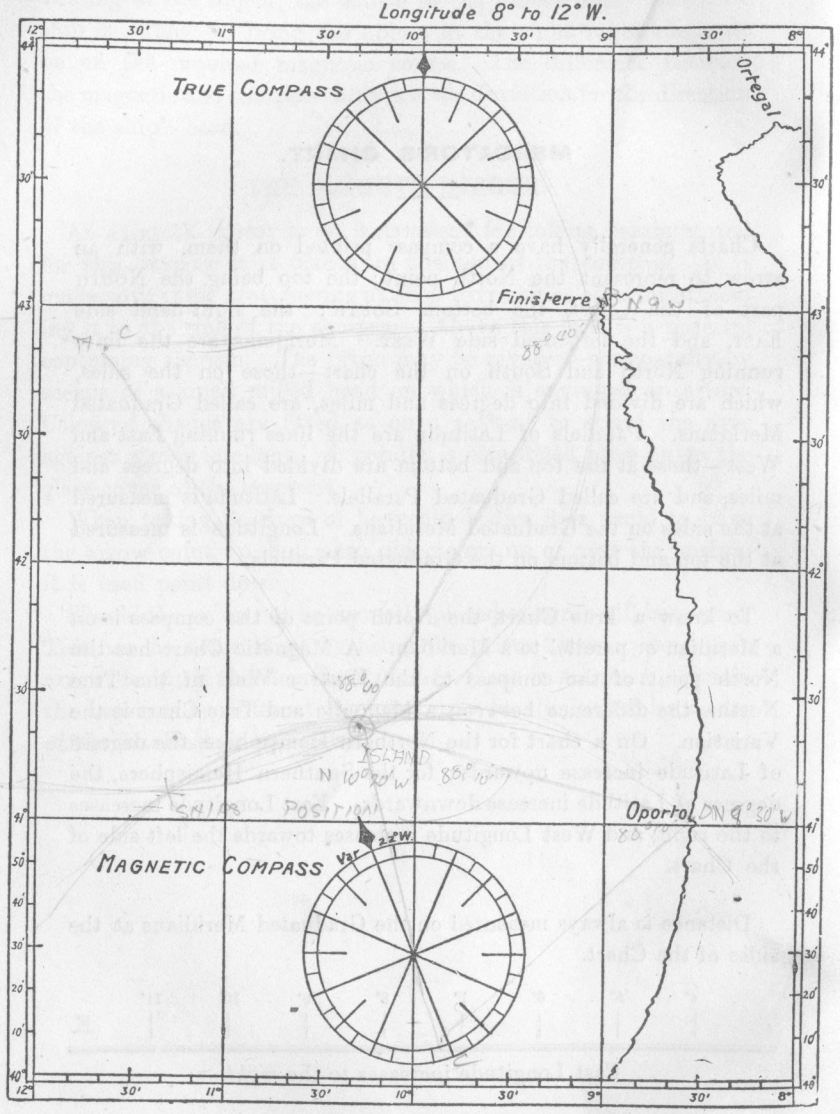
Distance is always measured on the Graduated Meridians at the sides of the Chart.



East Longitude increases to the *right*.

Fig. 48

Scale, 1 inch – Latitude 40° to 44° N.
Longitude 8° to 12° W.



	11°	10°	9°	8°	7°	6°	5°	4°	
W.	|	|	|	|	|	|	|	|	

West Longitude increases to the *left*.

	4°	3°	2°	1°	0°	1°	2°	3°	4°	
W.	|	|	|	|	|	|	|	|	|	E.

West Longitude. East Longitude.

	176°	177°	178°	179°	180°	179°	178°	177°	176°	
E.	|	|	|	|	|	|	|	|	|	W.

East Longitude. West Longitude.

True Course to find Compass Course.

Rule.—

Apply westerly variation and deviation to the right.

Apply easterly variation and deviation to the left. The result is the Compass Course.

Compass Bearings to get True Bearings.

Rule.—

Apply westerly variation and deviation to the left.

Apply easterly variation and deviation to the right. The result is the true bearing.

Questions and Answers.

How do you know a true chart? (*See* Fig. 43).

The North point of the compass is on a meridian or parallel to a meridian.

How do you know a magnetic chart? (*See* Fig. 43).

The North point of the compass will be placed to the right or left of the meridian, that is East or West of the true North.

What is the difference between a true and a magnetic chart?

The variation.

What is the variation of the compass?

Variation is the amount the North point of the compass is drawn to the right or left of the true North, caused by the magnetism of the earth. (The angle between the true and magnetic meridian.)

What is the deviation of the compass?

Deviation is the amount the North point of the compass is drawn to the right or left of the magnetic North, caused by the iron of the ship, or cargo. (The angle between the compass needle and the magnetic meridian.)

How do you know a chart for the Northern Hemisphere?

The degrees of latitude increase upwards.

How do you know a chart for the Southern Hemisphere?

The degrees of latitude increase downwards.

How do you know a chart for the Eastern Hemisphere?

The degrees of longitude increase towards the right-hand side of the chart, that is Eastwards.

How do you know a chart for the Western Hemisphere?

The degrees of longitude increase towards the left-hand side of the chart, that is Westwards.

Where do you measure latitude?

On a graduated meridian at the sides of the chart.

How do you measure distance?

Distance is always measured on a graduated meridian—half on each side of the middle latitude.

Where do you measure longitude?

Longitude is measured at the top or bottom on a graduated parallel.

What do you understand those small numbers to indicate that you see placed about the chart, and at what time of the tide?

Depths of water in fathoms or feet (as specified) at low water ordinary springs.

What do the Roman numerals indicate that are occasionally seen near the coast, and in harbours?

The time of high water at that place at full and change of the moon.

How would you find (approximately) the time of high water at any place, the Admiralty Tide Tables not being at hand, nor any other special Tables available?

To the time of high water at full or change of the moon, add 49 minutes for every day that has elapsed since full or change, the sum is the P.M. tide (approximately) for the given day.

FOUR-POINT BEARING.

How do you find the distance from a light by a 4-point bearing?

Take a bearing of the light when on the 4 points (*i.e.*, an angle of 45° from the ship's head), also note the log; when the light is abeam again read the log; the distance sailed between the 4-point bearing and the beam bearing is the distance off at the time of taking the second bearing. You must make due allowance for tide or current, if any.

STOWAGE OF CARGOES.

The chief officer is usually responsible for giving receipts for all cargo received on board, being assisted by the other officers in seeing the cargo properly stowed in the various holds.

It is most essential that the holds should be in a fit condition to receive the cargo, therefore attention should be given to their cleanliness.

Limber boards should be lifted, bilges cleaned and strums or rose boxes cleared of all dirt.

In most modern vessels the tank tops are covered or sheathed with close ceiling, consisting of $2\frac{1}{2}''$ or $3''$ planks laid on $2''$ bearers and for most cargoes this is sufficient, making it unnecessary to use further dunnage.

With other cargoes, such as rice, it is necessary to have a further $3''$ on the ceiling and about $6''$ at the bilge.

Casks.

A cargo of casks is stowed fore and aft, bung up and bilge free. The ground tier rests on soft wood beds placed athwartships under their quarters and are prevented from moving by having quoins (or wedge-shaped pieces of wood) jammed under each side.

The casks must be in line in a fore and aft direction, the head pieces of each longer being fair against the head pieces of the next longer. All broken stowage must be well dunnaged.

Casks are usually stowed "bilge and cantline", thus any one cask of the second tier rests on four of the ground tier.

The bung of a cask is readily found as it will be in line with the hoop rivets.

The number of tiers allowed for casks is 8, for hogsheads 6, for puncheons 4 and for pipes 3.

Should it be necessary to have further tiers a false deck must be erected.

Questions and Answers.

State the names of the hoops on a cask.

Chime, quarter, and bilge hoops.

How would you block off the ground tier in the wings?

With dunnage wood, keeping the bilges free.

After blocking off the ground tier, you find one of the casks damaged, how would you break it out?

I would parbuckle it out.

The ropes may be made fast on a stanchion, or toggled under the quarter of another cask; two planks or a skid can be used to roll the cask up on.

On how many casks does the second tier rest?

Four.

How would you sling a single cask on its end?

By passing the bight of a rope underneath (*see* fig. 44); another method of hoisting a cask by can hooks (*see* fig. 45).

Fig. 44.

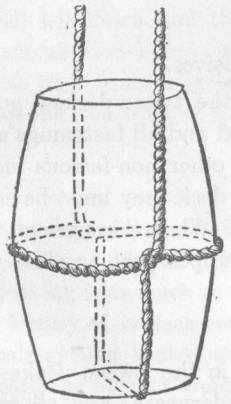
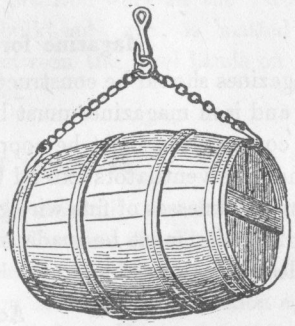


Fig. 45.



How do you stow cases?

Marks and numbers uppermost.

How would you stow bale goods?

On their flat, marks and numbers uppermost; wing bales should be stowed on their edges, so that in case of damage only a part of the bale will be damaged, and not the edges of each piece in the bale; also keep the marks inboard.

Where does broken stowage occur?

In the bilges, pump casing, stanchions, and around the masts.

You have three or four hundred tons of iron to take on board, how would you stow it?

From the fore part of the after hold to the after part of the fore hold, fore-and-aft till level with the keelson, then diagonal.

If you have bale goods to stow on top of the iron, what would you do?

I would lay dunnage wood, also mats to protect the bales from being chafed.

How would you separate different shipments of bar iron?

I would level off the first shipment, then place a strand of old wire across, and stow the second lot on top, or level down and cover over with mats, etc.

Magazine for Explosives.

Magazines should be constructed in the 'tween decks if possible. Steel and iron magazines must be lined and all fastenings used in their construction must be copper or other non-ferrous metal.

When the ventilators extend to the deck they must be covered by two thicknesses of fine wire gauze. When there are no ventilators 2″ holes must be made in the upper part as close to the overdeck as practicable.

Acids.

Acids should not be stowed either in the 'tween decks or the holds, but on deck with dunnage underneath, and all securely made fast; in the event of leakage it is advisable to throw the cases or carboys overboard.

Questions and Answers.

What is dead weight for?

To ballast the ship.

Where should it be stowed?

In the bottom of the vessel.

Where would you stow light goods?

In the 'tween decks or on top of heavy cargo.

If you have a cargo of dates, coffee and tea, how would you stow it?

The dates being dead weight, I would stow them in the lower holds, also the coffee, and the cases of tea on top and in the 'tween deck.

NOTE.—*Tea, coffee, etc., should be stowed separate from any cargo which has a strong odour, such as wet hides, etc.*

Jute or Cotton Cargoes.

Special attention should be given to see that the dunnage is well laid down, and that all the iron work in the various holds, such as stanchions, masts, bulkheads, etc., is matted over, so that no friction may occur between the steel bands on the bales and the iron work of the vessel.

Coal Cargoes.

A cargo of coal requires to be carefully attended to; it ought to be taken on board dry, and endeavours should be made to avoid breaking it as much as possible.

Plenty of surface ventilation is the best precaution against the coals getting heated and taking fire. When the coals are all on board the hatches should be left open, and every attention given to surface ventilation.

When a cargo of coal is all on board, the corners of each hatchway should be cleared away, and the hatches taken off in fine

weather; at sea the temperature of the holds should be frequently taken and entered in the log book daily.

A good plan is to enter the temperature of each hold in a note-book daily on one page; at a glance you can then detect any difference in the temperature of the holds.

In the event of fire it is advisable to batten down and close all openings, ventilators, etc. Then get all the hoses passed along, and between water and steam it is quite possible to keep the fire under. Should the fire gain rapidly the boats should be swung out and a few men directed to store them with provisions, etc.; and as a last resource abandon the vessel.

Cargo of Iron.

Operations should begin in the main-hold, and if no platform is required the iron should be stowed fore-and-aft until level with the keelson, then stow grating fashion. To protect the sides of the vessel, place rails fore-and-aft, and also have locking tiers of rails; when high enough lash all together with chains, and place deals across and tom all down securely from the beams; also put toms and shores from the sides of the vessel.

A cargo of iron should be stowed in the body of the vessel, trimmed towards the wings, and raised up in the holds to a good height; by doing so the vessel will be in better trim for rough weather, and will not roll so heavily.

Timber.

To moor a raft alongside the vessel bring it forward under the cat head, overhaul the cat fall, and hook the lower block on the chains of the raft, set taut, next place one or two guys on the fore and after ends of the raft; in a tideway raise the fore end of the raft a few feet, when the water will run underneath.

General Cargo.

Have all the holds cleaned up and dunnage laid down. (*See* rules for dunnage). Then consider the nature of the cargo, and

stow it in the various holds so that the vessel will be kept in good trim. In a steamship the quantity of coal in the bunkers will have to be taken into consideration. If the vessel has to call at a number of ports, the cargo should be stowed so that at the first port of call the cargo for that place will be handy for discharging.

Dead weight should be stowed in the lower holds, and used for trimming the ship; bale goods, etc., on top; tallow and butter should be kept in a cool place—in a steamer away from the engine room bulkhead; wines and spirits should be stowed in the 'tween deck aft, and a watch kept over them; bullion should be stowed in the strong room, and the door sealed up and secured with iron bolts.

A correct account of the cargo should be kept, also see that it all comes on board in good condition, and is stowed in a proper manner. The vessel should be kept upright, and, if possible, a few inches by the stern, so that the water can run to the pump wells; note the draught of water when the day's work is finished, also the amount of cargo taken on board. The wells should be sounded every morning and evening, hatches put on at night, and covered over with tarpaulins, and as the vessel goes down in the water the tanks should be pumped empty and carefully drained.

If you are in a roadstead discharging cargo, heavy swell on, how would you make a lee-side?

I would have a hawser out from the quarter pipe made fast to the cable, make the hawser fast aft, then veer some cable to bring the wind and sea about 2 or 3 points on the bow. The lee side will be comparatively quiet for working cargo.

Cargo of Rice.

To load a cargo of rice at one of the Burmah ports, the holds must be properly cleaned out, limbers and pump wells all examined, and dunnage laid down, generally bamboos covered over with matting.

After a few tiers of bags are stowed, ventilators are placed fore-

and-aft, also vertical ventilators are placed in position, and this system of ventilation is carried right up to the hatchways; consequently, when the vessel is laden and the hatches open, the holds are all well ventilated, and even with the hatches closed, the heat arising from the cargo will escape freely through the deck ventilators.

Cargo of Iron Ore.

A cargo of iron ore takes up so little space that when the vessel is down to her marks the various holds are not nearly full. This cargo of dead weight should be placed in the body of the vessel, raised up in the main hold, pinnacle fashion, and trimmed out towards the wings, also fore-and-aft to keep the vessel in trim. By stowing the cargo high up the vessel will behave better in a seaway.

Ventilation and Damaged Cargo.

The cargo is often damaged through faulty ventilation of the 'tween decks and the lower holds. When the hatches are all on, the air in the 'tween decks moves in the opposite direction to that of the wind.

When a vessel is loaded with coals special attention should be given to surface ventilation.

Ventilators should always be trimmed so as to allow the heated atmosphere to escape. In rough weather it may be necessary to unship the ventilators, the holes being closed with cowl tops, secured in some vessels with canvas covers lashed over all. If the bad weather continues for any length of time the warm air in the holds, coming in contact with the iron of the vessel, condenses into sweat (water), and if the holds are not well dunnaged the cargo is sure to be damaged.

If you find damaged cargo when discharging, on no account remove it, but report the matter to the master, so that he may take the necessary steps to have it surveyed.

Tarpaulins.

All the hatches should be covered over with two good tarpaulins, and one old one on top. If the cargo gets damaged through faulty tarpaulins the ship will be held liable. Consequently, when the cargo is all on board, the hatches should be carefully looked after and properly battened down.

Grain Cargo in Bulk.

Some vessels are specially constructed to carry grain, and have exempt certificates granted by the Board of Trade. Have all the holds, etc., cleaned out, and dunnage carefully laid down. The holds must then be divided into compartments by means of fore-and-aft shifting boards (3-inch deals) and athwart-ship bulkheads, the various compartments being grain-tight and strongly constructed from the bottom of the hold right up to the deck. The 'tween decks must be fitted up with feeders to feed the lower hold.

When the grain is coming on board it ought to be well trimmed into all the corners and tramped down, otherwise if the vessel encounters bad weather, she will probably take a heavy list by the cargo settling over to the lee side. All grain cargoes must be properly trimmed, stowed and secured.

If a vessel is not fitted up with properly constructed feeders, she must have not less than one fourth of the grain carried in each hold or compartment made up in bags (*i.e.*, one fourth of the grain in each hold shall be in bags), and before shipping the bags, matting and platforms must be laid upon the grain in bulk.

Ship's Draught.

The figures on the stem and stern are 6 inches in length, and the draught is taken from the lower edge of the figures. The mean draught is found by adding the two together and dividing by 2.

Oil Tank Steamers.

Steamers carrying oil are specially constructed for that purpose

each lower hold is a tank, with a trunk or feeder right up through the 'tween decks to the hatch combings. Pipes are also constructed inside and all around the tanks, and with the use of valves and a connecting rod from deck the oil, when loading, can be so regulated in the tanks that the vessel can at all times be kept upright and in good trim.

A coffer-dam is always constructed between the engine room and the tanks, also at each end of the vessel, and it is advisable to keep this space full of water.

Before connecting the shore pipe for loading, particular care should be taken that all lights are extinguished, and that no smoking is allowed about the decks.

Coffer-dam.

A coffer-dam is an enclosed space or water-tight barrier between two holds in an oil-tank steamer, or between two compartments in a warship. A coffer-dam may be constructed around a vessel which is partly submerged, and it is sometimes used for raising vessels which are stranded.

When discharging, the greatest care should be taken regarding naked lights and smoking. When the tanks are empty, it is most dangerous to enter them until they have been well ventilated. Gas is liable to remain in the corners, and for perfect safety the tanks should be washed out by the hose and afterwards steamed.

Note.—If the vessel is down by the head or stern the gas will always work to the lowest end, it being of greater density than the air.

Capacity of Bunkers and Holds.

How would you measure the capacity of a bunker or hold?

Multiply the length by the breadth, and their products by the depth; then divide by 40, which will give the number of tons at 40 cubic feet per ton measurement.

EXAMPLE.—Find the capacity of a hold 56 feet long, 30 feet wide, and 20 feet deep.

$$56 \times 30 \times 20 \div 40$$

$$\begin{array}{r} \times\ 30 \\ \hline 1680 \\ \times\ 20 \\ \hline \div 40)33600(840 \text{ tons, at 40 cubic feet per ton.} \\ 320 \\ \hline 160 \\ 160 \\ \hline \end{array}$$

Required the capacity of a bunker 40 feet by 10 feet by 8 feet.

$$40 \times 10 \times 8 \div 40$$

$$\begin{array}{r} 40 \\ \times\ 10 \\ \hline 400 \\ \times\ 8 \\ \hline \div 40)3200 \\ \hline \end{array}$$

Ans.—80 tons, at 40 feet per ton.

EXAMPLES FOR PRACTICE.

Required the capacity of a hold 20 feet by 10 feet by 15 feet.

Ans.—75 tons.

Required the capacity of a hold 40 feet by 30 feet by 20 feet.

Ans.—600 tons.

Required the capacity of a coal bunker which measures 50 feet by 12 feet by 10 feet.

Ans.—150 tons.

To Measure a Tank.

Multiply the length, breadth, and depth together, and the product by 6·25 = Gallons.

20 ft. × 10 ft. × 10 ft. ÷ 35 ft. = Tons.

20 ft. × 10 ft. × 10 ft. × 6·25 = Gallons.

A tank 20 feet deep by 10 feet by 10 feet. Find the capacity in gallons.

20 feet
× 10

200
× 10

2000
× 6·25 gallons = 1 cubic foot.

10000
4000
12000

12500·00 gallons.

Ans.—12,500 gallons.

A tank measures 10 ft. 6 ins. by 6 ft. 6 in. by 4 ft. Required the number of gallons it will contain.

10·5 × 6·5 × 4 = Cubic feet × 6·25 = Gallons.
10·5 × 6·5 × 4 = Cubic feet ÷ 35 = Tons.

10·5
× 6·5

525
630

6825
× 4

27300
× 6·25 gallons = 1 cubic foot.

136500
54600
163800

1706·2500 gallons.

Ans.—1706 gallons.

A tank measures 6 ft. by 4 ft. by 4 ft. *Ans.*—600 gallons.
A tank measures 8 ft. by 4 ft. by 2 ft. *Ans.*—400 gallons.
A tank measures 6 ft. 6 ins. by 5 ft. 6 ins. by 2 ft.
Ans.—446·8 gallons.

GRAIN CARGO.

In vessels loading a grain cargo, all proper and reasonable precautions must be taken to prevent the grain from shifting, under a penalty of £300.

A vessel is said to be laden with a grain cargo when that portion of the cargo consisting of grain is more than one-third of her registered tonnage. This is reckoned in measures of capacity at the rate of 100 cub. ft. to the ton for each ton of registered tonnage or when reckoned in weight at the rate of 2 tons weight for each ton of registered tonnage.

Grain cargo consists of any kind of cereals, rice paddy, pulse, seeds, nuts or nut kernels.

A vessel must not load heavy grain in bulk in the 'tween decks. She may carry oats, cotton seed or barley in bulk, but all other kinds of grain must be stowed in bags.

Where a vessel has 'tween decks and the lower hold is full of grain in bulk, suitable feeders must be erected from the 'tween deck coamings to the main deck coamings consisting of 3 ins. × 6 ins. uprights and 1½ ins. boards. This feeder must contain not less than 2 per cent. nor more than 6 per cent. of the quantity carried in the hold it feeds.

Many vessels are constructed with no laid 'tween decks and are allowed to carry full cargoes of grain in bulk. All vessels carrying bulk grain cargo must have a longitudinal bulkhead of shifting boards erected, generally consisting of 3 ins. spruce, with suitable supports, and are to be efficiently shored up from the vessel's side. When a vessel with no laid 'tween deck carries grain in bulk her hatch coamings must contain not less than 2 per cent. of the cargo in the compartment to act as a feeder to the hold.

Shifting boards must extend from the ceiling to the deck head, beam fillings being fitted and in the coamings right up to the hatches.

Some vessels are fitted with a double row of pillars or stanchions

between which the boards are placed; in other cases where only a single line of stanchions is fitted, a very strong method of securing the boards is made by having steel plates called shifting irons attached to the boards and stanchions by means of hook bolts 6 or 8 ft. apart.

When there are no stanchions in the hatchway, a strong method of keeping the boards in position is to have vertical angle bars stepped into plates in the ceiling and bolted to the web beams. These are supported by other angle bars attached to the 'tween deck coamings.

Another method is to have wooden uprights of 11 ins. by 3 ins. 8 ft. apart horizontally, with good shores (wooden spars) for every 5 feet depth of hold.

Instead of shores, 3 ins. wire stays set up by rigging screws are frequently used.

When a vessel is carrying heavy grain in bulk and will therefore be down to her marks before the end holds, at least, are full, the cargo must be secured by the following method. Not more than three-fourths of the cargo in such holds is allowed to be stowed in bulk; it is then levelled off and boards placed fore and aft not more than 4 ft. apart and athwartship boards not more than 9 ins. apart and the remaining one-fourth of the cargo in bags stowed on top of this platform.

It must be understood that vessels loading in Canadian, United States, Mediterranean or Black Sea ports must load according to the agreed rules. In the other parts of the world all reasonable precautions to prevent the grain shifting must be observed.

TIMBER DECK CARGO.

The term "timber deck cargo" means a cargo of timber carried on an uncovered part of a freeboard or superstructure deck. The term does not include wood pulp or similar cargo.

The structure of the ship is to be of sufficient strength for the deeper draught allowed and for the weight of the deck cargo.

The ship is to have a forecastle of at least standard height and at least 7 per cent. of the length of the ship, and in addition, a poop, or a raised quarterdeck with a strong steel hood or deck-house fitted aft.

Double bottom tanks where fitted within the midship half length of the ship are to have adequate longitudinal subdivision.

The ship must be fitted either with permanent bulwarks at least 3 feet 3 inches high, specially stiffened on the upper edge and supported by strong bulwark stays attached to the deck in the way of the beams and provided with necessary freeing ports, or with efficient rails of the same height as the above, and of specially strong construction.

Deck openings to spaces below deck are to be securely closed and battened down. All fittings, such as hatchway beams, fore and afters and covers, are to be in place. Where hold ventilation is needed the ventilators are to be efficiently protected.

Stowage.—The wells on the freeboard deck are to be filled with timber stowed as solidly as possible, to at least the standard height of a bridge. On a ship within a seasonal winter zone in winter, the height of the deck cargo above the freeboard deck is not to exceed **one-third the extreme breadth of the ship.**

Protection of crew.—Safe and satisfactory access to the quarters of the crew to the machinery space and to all parts necessary to the work of the ship is to be available at all times; the cargo to be stowed so that the openings can be properly closed and secured against the admission of water.

Gangways.—Efficient protection for the crew in the form of guard rails or life-lines, spaced not more than **12 inches apart vertically**, is to be provided on each side of the deck cargo to a height of at least **4 feet** above the cargo. The cargo is to be made sufficiently level for gangway purposes. Uprights when

required by the cargo are not to be more than 10 feet apart.

Lashings.—Timber deck cargo must be efficiently secured throughout its length by independent overall lashings spaced not more than 10 feet apart. Eye-plates for these lashings are to be riveted to the sheer strake at intervals of not more than 10 feet, the distance from an end bulkhead of a superstructure to the first eye-plate being not more than 6 feet 6 inches. Additional eye-plates may be fitted on the stringer plate.

Overall lashings are to be in good condition and are to be not less than $\frac{3}{4}$ inch close link chain or flexible wire rope of equivalent strength, fitted with sliphooks and stretching screws which are to be accessible at all times. Wire rope lashings are to have a short length of long link chain to permit the length of the lashings to be regulated. Steering arrangements are to be effectively protected from damage by cargo, and, as far as practicable, are to be accessible. Efficient provision is to be made for steering in the event of a breakdown in the main steering arrangements.

TANKERS.

The term "tanker" includes all steamers specially constructed for the carriage of liquid cargoes in bulk. They have less freeboard than ordinary cargo steamers and it is compulsory to have all hatchways on the freeboard deck and on the deck of expansion trunks made watertight by efficient steel covers. If fitted with bulwarks they are to have at least half the length fitted with open rails.

MEAT AND FRUIT.

Frozen meat is carried at a temperature of about			15° F.
Chilled	,,	,,	29° F.
Fruit, such as apples	,,	,,	40° F.
Bananas	,,	,,	52° F.

SOME STOWAGE FACTORS.

The undermentioned numbers are cubic feet to the ton.

Barley in bulk	about	52 to 56
Coffee in bags	,,	60
Cotton in bales	,,	60
Cotton seed in bulk	,,	100
Coal	,,	42 to 45
Coke	,,	80
Cement in casks	,,	44
Flour in bags	,,	50
Gunnies in bales	,,	60 to 63
Hides in bales	,,	50
Iron, pig	,,	10
Iron ore	,,	40
Jute in bales	,,	60
Linseed in bags	,,	60
Maize in bulk	,,	46
Maize in bags	,,	65
Oats in bulk	,,	80
Oil in casks	,,	50
Rye in bulk	,,	47 to 50
Rice in bags	,,	50 to 70
Sugar in bags	,,	45 to 50
Saltpetre in bags	,,	45 to 48
Tea in chests	,,	100
Timber	,,	70 to 80
Wheat in bulk	,,	46 to 48
Wheat in bags	,,	65
Zinc concentrates	,,	12

A shipping ton is 40 cub. ft.

NOTICES TO MARINERS.

The Admiralty issue weekly Notices to Mariners and the Board of Trade publish an annual book of Notices.

In addition, the various Authorities in Great Britain and Ireland issue special Notices regarding changes in lights, buoys, etc.

Some of the General Notices required to be memorised and therefore the following should be carefully read.

A CHAPTER ON WRECK-MARKING, LIGHT VESSELS, UNIFORM SYSTEM OF BUOYAGE, AND OTHER IMPORTANT MATTER FOR ALL GRADES.

BUOYING AND MARKING OF WRECKS.

Uniform System of Buoyage, with Questions and Answers.

PART I.

Preliminary—Caution.

While it may be assumed that care is taken to moor or anchor Wrk.-Mrk.-Vs. and buoys securely, and, when Lts. are used, to fit them with efficient lighting apparatus, yet Mariners should not place undue reliance on Wrk.-Mrk.-Vs. and buoys being maintained in position or on their Lts., as through heavy weather or other causes they are liable both to drag their moorings and to break adrift, and their Lts. are liable to be extinguished.

Mariners should regard these marks and Lts. merely as aids to nav., and while observing all proper precautions should give due heed to information contained in Notices to Mariners or to Messages received by wireless telegraphy or telephony as to the position and bearings of a wrk., and they should not assume that a wrk. has been removed from the position given by such Notice or Message merely because it may not be marked.

When two or more vessels and/or buoys are used to mark a wrk. a Mariner should not attempt to pass between them.

Mariners should always give a wrk.-mark a wide berth.

Colour for Wreck-Marking Purposes.

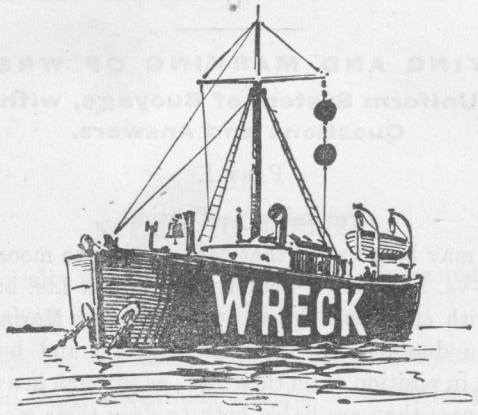
Green shall be the colour for all purposes connecting with wreck-marking, viz. :—

For Lts., Buoys, Balls, Shapes, Flags, Wrk.-Mrk.-Vs., &c.

Green colour should not be used—

(*a*) For Floating Lts. other than the *green* starboard side-light carried by ships under way.

(*b*) For Buoys and other markings afloat not used for wreck-marking purposes.



Vessels and buoys shall have the word "WRECK" painted in *white* letters on a *green* ground on their sides.

Part II.

For the Open Sea.—General.

Throughout the following Regulations the word "Port Hand" and "Starboard Hand" refer to the definition of those words given at the end of this Notice.

A Lt. on a Wrk.-Mrk.-V. shall be carried in a lantern so constructed as to show a clear and unbroken Lt. vis. all round the hor. at a dist. of at least one mile.

If a wrk.-marking buoy is lighted, the Lt. shall be carried in a lantern so constructed as to show a clear Lt. vis. all round the hor. at a distance of at least one mile.

The word "visible" when applied to Lts. shall mean vis. on a dark night with a clear atmosphere.

Shapes and Characteristics of Wreck-marking Buoys.

When a wrk-marking buoy is used it shall be one of the following shapes, and (if a Lt. is carried) it shall be lighted in one of the manners following to indic. to the Mariner on which hand he shall pass the buoy.

(*a*) To be passed on the Mariner's Port Hand—
Shape—Can.
Lt.—If lighted a *Green* Lt. giving 2 Fls.

(*b*) To be passed on the Mariner's Starboard Hand—
Shape—Conical.
Lt.—If lighted a *Green* Lt. giving 3 Fls.

(*c*) To be passed on either side—
Shape—Spherical.
Lt.—If lighted a *Green* Lt. giving 1 Fl.

Characteristics of Wreck-marking Vessels.

When a Wrk.-Mrk.-V. is used it shall carry the Lts. and shapes and give the sound sigs. following to indic. to the Mariner on which hand he should pass the vessel, viz. :—

(1) Lights.

(i) Between sunset and sunrise :—

(*a*) To be passed on the Mariner's Port Hand—
Two *green* Lts. in a vert. line not less than 6 ft. (1^m8) apart from the end of a crossyard, the lower Lt. to be of a height not less than 15 ft. (4^m6) above the hull.

(*b*) To be passed on the Mariner's Starboard Hand—
Three *green* Lts. in a vert. line not less than 6 ft. (1^m8) apart from the end of a cross-yard, the lowest Lt. to be of a height not less than 9 ft. (2^m7) above the hull.

(*c*) To be passed on either side—
Four *green* Lts., two in a vert. line one over the other, not less than 6 ft. (1^m8) apart, on each end of

a cross-yard with a hor. dist. between the Lts. at either end of the cross-yard not less than 15 ft. (4^m6) and not exceeding 25 ft. (7^m6). The height of the two lower Lts. to be not less than 15 ft. (4^m6) above the hull.

(ii) A Wrk.-Mrk.-V. shall not carry the ordinary riding Lt. for a vessel at anchor.

(2) Shapes—

Between sunrise and sunset to carry *green* balls or shapes corresponding in number and arrangement to the *green* Lts. as detailed above.

(3) Sound Signals—

A Wrk.-Mrk.-V. during fog, mist, falling snow, or heavy rain storms, whether by day or night, to ring a deep-toned bell at intervals of not more than 30 secs., as follows :—

(*a*) To be passed on the Mariner's Port Hand—
Two strokes in succession.

(*b*) To be passed on the Mariner's Starboard Hand—
Three strokes in succession.

(*c*) To be passed on either side—
Four strokes in succession.

DEFINITION of the words "Starboard Hand" and "Port Hand."

The term "Starboard Hand" shall denote that side which would be on the right hand of the mariner either going with the main stream of flood or approaching a harb., river, or estuary from seaward; the term "Port Hand" shall denote the left hand of the mariner under the same circumstances.

DIRECTION of the "Main Stream of Flood Tide."

The mariner, when approaching the coast, must determine his position on the chart, and must note the direction of the main stream of flood tide.

For the waters in the undermentioned districts the direction

of the main stream of flood tide shall, for the purpose of this system of buoyage, be deemed to be as follows :-

(i) English Chan., N. and E. Coasts of Great Britain (excluding the Moray Firth, Firth of Forth and the Wash), the Pentland Firth, and between Orkney and Shetland Isls.	Towards the Estuary of the Thames.
(ii) The St. George's Chan. and Irish Sea (excluding the Bristol Chan.) and on the N. Coast of Ireland (Tory Isl. to Rathlin Isl.) and S. Coast of Ireland (Skelligs Rks. to Carnsore Pt.).	Towards the Solway Firth on the E. and towards Lough Strangford on the W.
(iii) W. Coast of Ireland from Skelligs Rks. to Tory Isl.	To the Nrd.
(iv) W. Coast of Scotland, N. of Mull of Cantyre, including the Hebrides.	Towards Cape Wrath.
(v) E. and W. Coasts of Orkney and Shetland Islands.	To the Srd.

PART III.

For Narrow Waters and in Rivers, Harbours, Estuaries and the Approaches thereto.

(1) The Regulations for marking a Wrk. in the Open Sea (Part II.) should be followed unless the Authority having jurisdiction in the locality should in their discretion determine otherwise, but in all cases the colour *Green* is used.

(2) (*a*) Where in the discretion of the Authority a different method of marking a wrk. is adopted, the Authority in the Notice to Mariners which they publish and circulate shall describe the method of marking with sufficient particulars to enable the Mariner to locate the position of the wrk.

(*b*) When a different method of marking a wreck is adopted, if any mark, light or sound signal of the description set out in Part II. is used it shall have the significance attached to it in that Part.

Description of Lights on Light-Buoys.

It has been decided to adopt the following characters for the single, double and triple flash lights to be exhibited from lighted buoys used for wreck-marking purposes:—

Coasts of the United Kingdom.

(*a*) Port hand buoys.
Green light giving 2 flashes every 10 secs.

(*b*) Starboard hand buoys.
Green light giving 3 flashes either every 10 secs. or every 15 secs.

(*c*) Buoys to be passed on either side.
Green light giving 1 flash every 5 or 6 secs.

Questions on Wreck Marking.

What is the colour for wreck-marking purposes?

Green for buoys, balls, shapes, and flags.

At what distance can a wreck-marking light be seen?

It is visible all round the horizon at a distance of at least one mile.

What are the shapes of wreck marking buoys?

Can, conical, and spherical.

On which side of a spherical buoy will you pass?

It may be passed on either side.

A vessel showing four green lights, two in a vertical line one over the other; on which side will you pass?

I can pass on either side.

What is the horizontal distance between the lights?

Not less than 15 ft. and not exceeding 25 ft.

What is the height of the two lower lights?

Not less than 15 ft. above the hull.

Does a wreck-marking vessel carry the ordinary light for a vessel at anchor?

No.

What is the characteristic of a wreck-marking vessel in the daytime?

Between sunset and sunrise she will carry green balls or shapes corresponding in number and arrangement to the green lights.

What are the sound signals in fog and mist?

To be passed on the mariner's port hand, two strokes in succession on a deep-toned bell at intervals of not more than 30 seconds. To be passed on the mariner's starboard hand, three strokes. To be passed on either side, four strokes in succession.

If you observe two or more vessels and/or buoys for wreck marking, will you pass between them?

No. Mariners should not attempt to pass between them, and should always give a wreck mark a wide berth.

What is the definition of the words "Starboard hand" and "Port hand"?

The term "Starboard hand" shall denote that side which would be on the right hand of the mariner either going with the main stream of flood or approaching a harbour, river, or estuary from seaward; the term "Port hand" shall denote the left hand of the mariner under the same circumstances.

Can you depend on wreck-marking vessels and buoys being maintained in position?

No. Owing to heavy weather, they are liable to drag their moorings and to break adrift, and their lights are liable to be extinguished.

LIGHT-VESSELS.

A light-vessel on her station shows, in addition to her distinguishing light, a white light from the fore-stay just above the rail to show in what direction she is riding.

When a light-vessel is unable to exhibit her usual lights whilst on her station, the riding light only is shown.

Watch-buoys are painted red with "WATCH," preceded by the light-vessel's name in white letters.

If a vessel is seen standing into danger, the urgent two-flag signal—J. D. (you are standing into danger)—will be hoisted and kept flying until answered, and, in addition to above signal, the lightvessel will fire a gun or socket signal, and repeat it at short intervals until answered by the vessel.

Collisions with Light-Vessels.

Caution.—In consequence of various light-vessels having been run into on several recent occasions by vessels navigating in their vicinity, whereby the lives of the men on board the light-vessels have been seriously endangered, the attention of mariners is drawn to the importance of making due allowance for the set of the tide and of exercising every precaution in order to *give all light-vessels a wide berth*, especially when crossing their bows in a tideway, which should never be attempted unless absolutely necessary.

Attention is specially drawn to Section 666 of the Merchant Shipping Act, 1894, which provides that any person wilfully or negligently running foul of any lightship or buoy shall, in addition to the expense of making good any damage so occasioned, be liable for each offence to a fine not exceeding £50.

SYSTEM OF BUOYAGE ADOPTED BY THE GENERAL LIGHTHOUSE AUTHORITIES OF THE UNITED KINGDOM.

Uniform System of Buoyage.

1. The mariner, when approaching the coast, must determine his position on the chart, and must note the direction of the main stream of flood tide.

2. The term starboard hand shall denote that side which would be on the right hand of the mariner either going with the main stream of flood or entering a harbour, river, or estuary from seaward; the term port hand shall denote the left hand of the mariner under the same circumstances.

3. Buoys showing the pointed top of a cone above water shall be called conical, and shall always be starboard hand buoys as above defined.

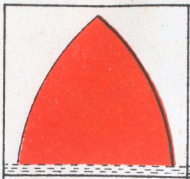
4. Buoys showing a flat top above water shall be called can, and shall always be port hand buoys, as above defined.

5. Buoys showing a domed top above the water shall be called spherical, and shall mark the ends of middle grounds.

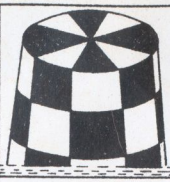
6. Buoys having a tall central structure on a broad base shall be called pillar buoys, and like other special buoys such as bell buoys, gas buoys, automatic sounding buoys, etc., shall be placed to mark special positions either on the coast or in the approaches to harbours, etc.

7. Buoys showing only a mast above water shall be called spar buoys.

8. Starboard hand buoys shall always be painted in one colour only.



CONICAL BUOY
STARBOARD HAND



CAN BUOY
PORT HAND

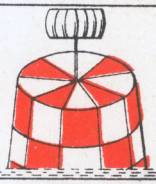
WHISTLE BUOY

SPAR BUOY
MARKS SPECIAL
POSITION. END OF SPIT

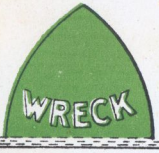
STAFF AND DIAMOND
OUTER END
OF MIDDLE GROUND

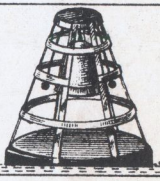
STAFF AND TRIANGLE
INNER END
OF MIDDLE GROUND

STAFF AND GLOBE
STARBOARD HAND



STAFF AND CAGE
PORT HAND





WRECK MARKING BUOYS

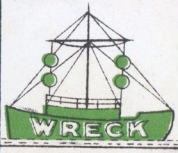
STARBOARD HAND | PORT HAND | PASS ON EITHER SIDE | BELL BUOY

TELEGRAPH BUOY

PILLAR BUOY
USUALLY MARKS
FAIRWAY

WATCH BUOY
MOORED NEAR
LIGHT VESSEL

SPOIL BUOY
MARKS
SPOIL GROUND



TO BE PASSED ON
MARINER'S PORT HAND

TO BE PASSED ON
MARINER'S
STARBOARD HAND

TO BE PASSED ON
EITHER SIDE

LIGHT VESSEL
OUT OF POSITION

THE TERMS "STARBOARD HAND" AND "PORT HAND" ARE
DEFINED IN "THE UNIFORM SYSTEM OF BUOYAGE,"

9. Port hand buoys shall be painted of another characteristic colour, either single or parti-colour.

10. Spherical buoys at the ends of middle grounds shall always be distinguished by horizontal stripes of white colour.

11. Surmounting beacons such as staff and globe, etc., shall always be painted of one dark colour.

12. Staff and globe shall only be used on starboard hand buoys. (*See* chartlet.)

13. Staff and cage on port hand, diamonds at the outer ends of middle grounds, and triangles at the inner ends.

14. Submarine telegraph cable buoys are painted black with the word telegraph in white letters painted on them.

15. Admiralty charts.—A red buoy is known by the letter R, and a black buoy by the letter B being placed against it; a buoy with black and white vertical stripes has the letters B.W.V.S. placed alongside it.

Describe a nun-buoy.

A nun-buoy is a buoy tapering at each end, used by yachtsmen for picking up moorings.

DISTRESS SIGNALS.

II.—VISUAL AND SOUND SIGNALS.

The experience of the Board of Trade shows that two of the existing statutory distress signals, viz., "a continuous sounding with any fog-signal apparatus" and "flames on the vessel," are not only liable to abuse, but when used as distress signals have often given rise to misunderstanding. A succession of signals on the whistle or siren is frequently made for other purposes than of indicating distress, *e.g.*, for summoning a pilot, and may be mistaken for a "continuous sounding." Similarly, working lights

and "flare up" lights are authorised for use by fishing vessels and other small craft, and the simplest way of making a "flare up" light is to dip a rag in paraffin and set it alight. Unfortunately, small vessels in distress frequently make the signal "flames on the vessel" in the same manner. Thus it is often impossible to decide whether "flare up" lights are being shown or whether distress signals are being made, especially in areas where fishing is carried on. As a result, uncertainty and delay have occurred and lives have been lost in consequence.

Distress signals should be as distinctive as possible, so that they may be recognised at once and assistance despatched without delay. Thus, instead of making an indefinite succession of blasts on the fog signalling apparatus when in distress, mariners should make the "continuous sounding" by repeating the Morse signal S O S (– – – — — — – – –) on the whistle or fog horn. If this is done there can be no mistake as to the meaning of the signal. Similarly, by night, if signalling for help by means of a lamp or flashing light the same signal S O S should always be used.

As regards the "flames on the vessel" signal, unless the flames making the signal are sufficiently large to attract immediate attention their chances of being recognised as a distress signal are very poor. The best distress signal is the signal rocket, and wherever possible a supply of rockets should be carried. Where this is not practicable an effective firework signal, which can be held in the hand while being discharged, should be provided in place of the rockets; such a signal should show a brilliant *red* flare and throw five or more *red* stars to a height of 80 feet. Failing either of these two signals a supply of ordinary *red* flares should always be carried. These *red* flares are now recognised by general custom as distress signals, and, though not so effective as either rockets or the hand firework, are much more distinctive than the burning of rags, articles of clothing, etc., soaked in paraffin, which should be used only as a last resource. Use should not be

made of these *red* flares in any circumstances for any other purpose than that of indicating distress. 18*th Nov.* 1929 (36/2060).

Signals used in connection with the Life-Saving Services on the Coast of Great Britain and Northern Ireland.

Signal.	*Signification.*
(*a*) *Signals to Vessels in Distress.*	
Rocket throwing *white* stars or *white* flare.	Distress signal or plight observed — Assistance summoned.
One explosive sound signal showing bright *white* star on bursting.	Distress signal or plight observed — Life-saving apparatus called out.
Two explosive sound signals, showing bright *green* stars on bursting.	Distress signal or plight observed — Lifeboat called out.
Three explosive sound signals, the first showing *white* star on bursting and the second and third *green* stars.	Distress signal or plight observed — Life-saving apparatus and lifeboat called out.

Note 1.—By day a *red* flag (rectangular or swallow-tailed) will be flown when the life-saving apparatus is called out, and a *red* flag (*triangular*) when the lifeboat is called out.

Note 2.—Certain pyrotechnic signals consisting of three or more rockets throwing *white* stars on bursting or a *green* flare turning to *white* are used on occasions for communication between the shore and a lifeboat. A lifeboat when out on service may make any of the following signals:—A *white* flare to indicate that she is approaching a wreck. *Red* flares to indicate to the shore that more aid is required and a *green* or *green* turning to *white* flare to notify to those ashore that she is returning.

Signal.	*Signification*
(*b*) *Landing Signals.*	
By day.—Flag held upright over head. *By night.*—*White* flare held steady or stuck in ground.	You may attempt to land here.
By day.—Flag waved from side to side. *By night.*—*White* flare waved from side to side.	Landing is extremely dangerous. You are advised to lay off until lifeboat arrives.
By day.—Flag waved to right or left and then pointed in direction. *By night.* — *White flare* held steady and carried along shore to right or left.	The best landing will be found in the direction in which flag is pointed or light carried.
By day.—Two flags held upright overhead, the men holding them being about 50 yards apart in line of approach. *By night.*—Two *white* flares held or stuck in ground or two bonfires placed as above.	You should attempt to land and by this line of approach.
(*c*) *Standing into Danger Signals.*	
The International Code Signal J.D. The letter U (– – —) flashed by lamp or made by foghorn, or whistle, etc.	You are standing into danger.

Note.—If it should prove necessary, the attention of the vessel is called to these signals by a *white* flare, a rocket showing *white* stars on bursting, or an explosive sound signal. 1*st Dec.* 1931 (23/66).

LIGHT-VESSEL—SIGNALS WHEN OUT OF POSITION.

When any manned light-vessel off the coasts of the United Kingdom and Ireland is driven from her proper position to one where she is of no use as a guide to shipping, the balls or distinguishing masthead marks will be struck if practicable, the characteristic light will not be shown and the fog signal will not be sounded, but the following signals will be made:—

By day.—Two large black balls will be shown, one forward and one aft, and the International Code signal PC, indicating "I am not in my correct position" will be hoisted.

By night.—A red fixed light be shown at each end of the vessel and red and white flares shown simultaneously at least every 15 minutes; if the use of flares is impracticable, a red light and a white light will be displayed simultaneously.

Caution when approaching British Ports.

PART I.—CLOSING OF PORTS.—(1) My Lords Commissioners of the Admiralty, having taken into consideration the fact that it may be necessary to forbid all entr. to certain ports of the Empire, this is to give Notice that on approaching the shores of the British Isles, or any of the ports or localities of the British Empire, a sharp look-out should be kept for the sigs. described in the following paragraph, and for the vessels mentioned in paragraph (5), Part II., of this Notice, and the disting. and other sigs. made by them. In the event of such sigs. being displaced, the port or locality should be approached with great caution, as it may be apprehended that obstructions may exist. (2) **If entr. to a port is probibited, 3 *RED* Lts. vertically disposed by night, or 3 *RED* balls vertically disposed by day, will be exh. in some conspicuous position in or near to its approach, which sigs. will also be shown by the vessels indic. in paragraph (5), Part II., of this Notice. If these sigs. are displayed, vessels must approach the port with the greatest caution, and implicitly obey all orders or sigs. given them by the Exam. vessel or sig. station. (3) At**

some ports or localities at home or abroad, searchlights are occasionally exh. for exercise. Instructions have been given to avoid directing movable searchlights during practice on to vessels under way, but Mariners are warned that great care should be taken to keep a sharp look-out for the sigs. indic. in paragraph (2) above, when searchlights are obs. to be working.

PART II.—EXAMINATION SERVICE.—(4) In certain circumstances it is also necessary to take special measures to exam. vessels desiring to enter the ports or localities at home or abroad. (5) In such case, vessels carrying the disting. flag or Lts. mentioned in paragraph (7) will be charged with the duty of exam. ships which desire to enter the port and of allotting positions in which they shall anchor. If Government vessels, or vessels belonging to the local port authority, are found patrolling in the offing, merchant vessels are advised to communicate with such vessels with a view to obtaining information as to the course on which they should approach the Port. Such communication will not be necessary in cases where the Pilot on board has already received this information from the local authorities. (6) As the institution of the Exam. Service will probably be unknown to vessels desiring to enter the port, especial care should be taken in approaching the ports, by day or night, to keep a sharp look out for any vessel carrying the flags or Lts. mentioned in paragraph (7), and to be ready to "bring to" at once when hailed by her or warned by the firing of a gun or sound rocket. In approaching by night any port in the British Empire, serious delay and risk will be avoided if 4 efficient all round lanterns, 2 *red* and 2 *white*, are kept available for use. (7) **By day** the disting. flag of the Exam. Steamer will be a special flag (*white* and *red* hor. surrounded by a *blue* border). Also 3 *red* balls vertically disposed if entr. is prohibited.

Usually the Examination Steamers will fly the *blue* ensign, but in certain circumstances they may fly the *white* ensign.

By night the steamer will carry:—(*a*) Three *red* Lts. vertically

disposed if entr. is prohibited. (*b*) Three *white* Lts. vertically disposed if entr. is permitted. The above Lts. will be carried in addition to the ordinary nav. Lts., and will show an unbroken Lt. around the horizon. (8) Merchant vessels approaching a British port at which the Examination Service is in force must hoist their signal letters on arriving within visual signal distance of the port, and are not to wait for the signal, "What ship is that?" to be made from the Examination Steamer. (9) Masters are warned that before attempting to enter any port when the Exam. Service is in force, they must, in their own interests, strictly obey all instructions given to them by the Exam. Steamer.

Whilst at anchor in the Exam. anchorage, Masters are warned that it is forbidden, except for the purpose of avoiding accident, to do any of the following things, without permission from the Exam. Officer:—To lower any boat. To communicate with the shore or with other ships. To move the ship. To work cables. To allow any person or thing to leave the ship. (10) In case of fog, Masters are enjoined to use the utmost care, and the port should be approached with caution. (11) When the Exam. Service is in force, Merchant vessels when approaching ports are especially cautioned against making use of private sigs. of any description, either by day or night; the use of them will render a vessel liable to be fired on. (12) The Pilots attached to the ports will be acquainted with the regulations to be followed.

PART III.—MINE-SWEEPING OPERATIONS.—H.M. Vessels engaged in mine-sweeping operations or exercises are hampered to a considerable extent in their manoeuvring powers. With a view to indic. the nature of the work on which they are engaged, these vessels will show the sigs. hereinafter mentioned. For the public safety, all other vessels, whether steamers or sailing craft, should endeavour to keep out of the way of vessels flying these sigs. and not approach them inside the dists. mentioned herein, specially remembering that it is dangerous to pass between the vessels of a pair, or group sweeping together.

1. SIGS. SHOWN BY DAY.

(*a*) By vessels working singly:—A *black* ball at the foremast head and a similar ball at the yard-arm or where it can best be seen on that side on which it is dangerous to pass. (If a ball is shown at each yard-arm it is dangerous to pass either side.)

Vessels showing this sig. should not be approached nearer than 900 yds. (823^{m}0).

(*b*) By vessels working in pairs or groups:—A *black* ball at the foremast head and a similar ball at the yard-arm or where it can best be seen on that side on which it is dangerous to pass. Vessels should not pass within a dist. of 400 yds. (366^{m}0) astern of a pair or group of sweepers, or when more than one pair or group are working in company within a dist. of 400 yds. (366^{m}0) astern of rear pair or group. They should on no account attempt to pass between pairs or groups working in company.

2. SIGS. SHOWN BY NIGHT.

As for day, except that all round *green* Lts. will be used in a similar manner to and in place of the *black* balls.

Caution with regard to Single Ships approaching Squadrons or Aircraft Carriers.

Former Notice.—No. 7 of 1936.

1. The attention of shipowners and mariners is called to the danger to all concerned which is caused by single vessels approaching a squadron of warships so closely as to involve risk of collision, or attempting to pass ahead of, or through, such a squadron.

2. Mariners are warned that it would be in the interests of safety for single vessels to adopt early measures to avoid approaching a squadron under the above conditions which might involve risk of collision and to keep out of its way.

3. Attention is also drawn to the uncertainty of the movements of aircraft carriers which must necessarily turn into the wind when aircraft are taking off or landing.

4. In circumstances where a single vessel has not taken early measures to keep out of the way of a squadron or aircraft carrier, the "Regulations for Preventing Collisions at Sea" must be the guide.

Note.—This Notice is a repetition of the former Notice quoted above.

Warning Signals displayed by British Vessels to denote presence of Submarines.

1. Attention is drawn to the following warning signal which is in use to denote the presence of submarines:

British vessels fly a rectangular *red* flag to denote that submarines, which may be submerged, are in the vicinity. Vessels are cautioned to steer so as to give a wide berth to any vessel flying such a flag. If from any cause it is necessary to approach her, vessels should proceed at slow speed until warning is given of the danger zone by flags, semaphore or megaphone, etc., a good look-out being kept meanwhile for submarines whose presence may be only indicated by their periscopes showing above water.

A submarine submerged at a depth too great to show her periscope may sometimes indicate her position by releasing a "smoke candle" which gives off a considerable volume of smoke on first reaching the surface, or by a discharge of oil.

2. Under certain circumstances warnings that submarines are exercising in specified areas may be broadcast by a General Post Office W/T station.

3. It must not be inferred from the above that submarines exercise only when in company with escorting vessels.

Vessels Navigating Stern Foremost.

The Board of Trade have been consulted with regard to the signals to be shown by vessels which are fitted with bow rudders and are navigated stern foremost when entering or leaving certain ports and harbours in the United Kingdom and abroad. The Board have agreed with the owners of the British vessels chiefly concerned that the following signal should be displayed by such vessels to indicate that for the time being they are navigating stern foremost:—

Two balls, each two feet in diameter, carried at the ends of a horizontal jackyard on the mast, or, if the vessel has more than one mast, on the main or after-mast. The jackyard will be placed in a thwartship direction, at least six feet higher than the funnel top, and will project at least four feet on either side of the mast, so that the distance between the centres of the two balls will be at least eight feet.

Bye-laws giving effect to this arrangement have been made for the ports of Dover, Ramsgate, Holyhead, Larne and Belfast.

Special Signals and Lights Displayed by British, Swedish, Danish and Dutch Seine Net Fishing Vessels.

The following signals have been agreed upon by the Fishing Industry for the use of British, Swedish, Danish and Dutch seine net fishing vessels, when actually fishing with seine nets, for the purpose of protecting their gear from injury by other vessels.

By day.—One *black* ball, basket or shape, in the fore part of the vessel as near to the stem as possible, not less than 10 ft. above the rail.

One *black* cone apex upwards on the yardarm on the mizzen mast on the side from which the net is being operated. (Dutch fishing vessels may use a triangle in place of a cone.)

By night.—Three *white* lights in a triangle, the sides of which are approximately 2½ ft. (0^m7), apex upwards, from the yard on the side of the vessel from which the gear is leading. The signal is to be used in conjunction with the side-lights when running the gear and without the side-lights when hauling the gear. In neither case should the masthead light be shown.

**Sound Signal.*—For British, Swedish, Danish and Dutch vessels:—Three long and one short blasts on the whistle when being approached by other vessels.

The above signals will indicate that a vessel is engaged in fishing with a seine net, in order that other vessels approaching may give the seine net vessel a wide berth.

The area covered by the nets and warps may be as much as a square mile in extent.

When a vessel of this description is at anchor at night and not working gear the usual anchor lights as prescribed by Article 9 of the Regulations for Preventing Collisions at Sea, 1910, will be shown and no other lights should be exhibited.

* *Note.*—In fog, mist, falling snow and heavy rainstorms the

usual fog signals for all fishing vessels prescribed by Article 9 of the Regulations for Preventing Collisions at Sea, 1910, shall be given. *April* 1928.

Damage to Drift Nets.

Extensive damage has been caused to the nets of drifters fishing in the Firth of Forth, Irish Channel and off the South West Coast of England and the Scilly Isles, through the failure of both cargo and passenger steamers to comply with the necessary precautions as laid down in the various Sailing Directions.

When passing through a fleet of drift net fishing vessels, it should be borne in mind that these nets often extend for a distance of 4 miles from the drifter, and every care should be taken to avoid damage to the nets when passing through the fleet.

In the Irish Channel where the nets are set from sundown to sunrise, masters are requested to exercise all reasonable care when in this position so as to avoid crossing the nets. Flares are displayed by fishermen when vessels are observed to be bearing down on their trains of nets.

GREAT BRITAIN.

Light-Vessels.—"Off Station" signals.

The following "*Off station*" signals are made by N. Carr light-vessel (56° 18′ N., 2° 33′ W.), Abertay light-vessel (56° 27′ N., 2° 42′ W.), and all light-vessels in England and Wales:—(1) When a light-vessel is from any cause not at its station, its characteristic light or characteristic fog signal will not be in operation. (2) A light-vessel which has dragged or broken adrift from its moorings will strike, if possible, its characteristic day-mark and will hoist:—By day.—Two *black* balls, one forward and one aft, International Code Signal indicating name of station and "P.C." indicating light-vessel out of position. By night.—Two *red* lights one forward and one aft, and in addition will

show every quarter of an hour simultaneously two flares, one *red* and the other *white*. When circumstances render it impracticable to use flares, a *red* and a *white* light will be displayed simultaneously. *Note.*—Light-vessels in the Humber and approach when off station will exhibit a *white* flare to attract the attention of a passing vessel at night. 1*st June* 1931 (34/878).

Signal Exercises with Aircraft.

Arrangements have been made between the Air Ministry, the Board of Trade, and shipowners for signal exercises to be carried out between certain merchant ships fitted with daylight flashing apparatus and aircraft in flight.

The exercises will be similar to those carried out between H.M. ships and merchant vessels except that, in addition to flashing, the aircraft may request a W/T exercise to be carried out.

In view of the difficulty of recognising individual ships from the air, it is possible that ships not fitted with daylight flashing apparatus may be approached and called up by aircraft.

In such cases the hoisting of flag "N" indicating "Negative" will inform the aircraft that no flashing apparatus is available or that it is inconvenient to attend to the call, or, if any vessel be called and would care to receive the signal from aircraft, the answering pennant used in the ordinary manner should be hoisted.

Communications with Aircraft.

In view of the great assistance which is afforded to flying boats by ships as regards checking their position and course, particularly when out of sight of land, masters are requested to instruct wireless telegraph operators to establish communication whenever possible with any flying boat observed in the vicinity, even during an off watch period, in order to ascertain whether information of this nature is required. Flying boats desiring to communicate with ships usually call on the 500 kc/s (600 m.) wave,

but cases have occurred in which these calls have not been answered, owing to the fact that they were made during one of the off watch periods of the one operator ships. 1*st Feb.* 1930 (36/2102).

Lights Exhibited by all Aircraft at Anchor.

Notice is given that in order to minimise the risk of being run into at night, aircraft of all nationalities, when at anchor or moored on the water, will exhibit:—

(*a*) Forward centrally where it can best be seen, a *red* light, 3 feet (0^m9), vertically above a *white* light. The lights to be visible all round the horizon for a distance of at least one mile (two kilometres).

(*Note.*—On April 1, 1937, the above *red* light will be abolished and only the *white* light retained.)

(*b*) If the aircraft is of 150 feet or upwards in length, a *white* light at or near its stern at a lower height than the forward lights and visible so far as practicable all round the horizon at a distance of at least one mile.

(*c*) If the maximum span of the aircraft is 150 feet, or more, in addition to the lights specified in (*a*) above or those specified in (*a*) and (*b*) above, a *white* light on each side placed in such a manner as to demarcate the maximum lateral dimension of the aircraft, and visible so far as practicable all round the horizon at a distance of at least one mile.

Submarine Cables.—Instructions as to Procedure when Fouled.

The following instructions are promulgated for the purpose of preventing serious damage to submarine cables which have been fouled by a vessel's anchor or in any similar circumstances:—

In the event of a submarine cable being lifted to the surface on the anchor, the vessel should be manoeuvred in such a manner as to prevent the anchor slipping along the cable which is liable to cause damage to the cores of the cable. A four or five-inch manila or hemp rope should be passed round the cable, the end being brought inboard and made fast ready for slipping. The rope must not be made fast to the cable and a wire hawser should on no account be used provided that a manila or hemp rope is

available. The anchor should then be lowered clear of the cable which can then be slipped.

Masters of vessels having fouled a submarine cable are particularly requested to report the occurrence to the nearest cable station by wireless or by the quickest means available, giving the position by sextant angles or bearings if in sight of land or navigational aids. *March* 1925.

Tankers—Use of Rocket Line-Throwing Apparatus.

Attention is called to the danger of attempting to establish communication, by means of a rocket line-throwing apparatus, with an oil tanker, should that vessel be carrying petrol spirit or other highly inflammable liquid and be leaking. In such a case *the assisting vessel should lie to windward of the tanker* and the communication should be established from the ship requiring assistance. *Therefore before firing a rocket to such a vessel, it should be ascertained whether it is safe to do so.* 1*st June* 1929 (36/1986).

Tankers—Additional Directions for the Use of Rocket Line-Throwing Apparatus.

When a vessel in distress is carrying petrol spirit or other highly inflammable liquid and is leaking the following signals should be exhibited to show that it is dangerous to fire a line carrying rocket by reason of the risk of ignition,

By day.—Flag B of the International Code of Signals hoisted at the masthead.

By night.—A red light hoisted at the masthead.

When visibility is bad the above signals should be supplemented by the use of the following International Code signal made in sound:—

MQF (— — — — · — · · · — ·) "It is not safe to fire a Rocket."

Note.—Attention is also called to the International Code signal:

MQH (— — — — · — · · · ·) "Is it safe to fire a Rocket?"

Line-Throwing Appliances.

Every ship of 500 gross tonnage and upwards shall carry an approved type of line-throwing appliance.

1. An approved line-throwing appliance shall consist of—

(*a*) Four line-throwing rockets with sticks or other approved apparatus capable of throwing a line ½ inch in circumference, a distance of 200 yards in calm weather; and

(*b*) Four lines, ½ inch in circumference, each not less than 240 yards in length, having a breaking strain of not less than 250 lbs.

2. The rockets with the means of igniting them and the lines shall be kept in a watertight case.

British Empire.

Signal to be made when Inconvenienced by Searchlight.

Any vessel approaching a port in the British Empire when searchlights are being worked and fearing that they may interfere with her safe navigation may make the signal "ZO" either (*a*) by flashing lamp, (*b*) by whistle, siren or foghorn.

Load-Line and Draught of Water.

Statutory Rule and Order, 1930, No. 233 of the 31st March, 1930, made by the Board of Trade under Section 443 of the Merchant Shipping Act, 1894, which came into force on the 1st October, 1930, requires the master of every ship registered in the United Kingdom marked with a load-line to enter in his official log book particulars of the draught of water and freeboard amidships of his ship on leaving any dock, wharf, place or harbour. The particulars required are somewhat more detailed than those hitherto required and, pending the revision of the official log books to meet these requirements, the necessary particulars should be recorded in a supplemental official log book.

In addition, the master of every ship employed outside home trade limits is required to post up a "Notice" on board so as to be legible to all members of the crew, giving particulars of the ship's draught and freeboard on sailing.

Section II.

SIGNALLING.

THE 1931 INTERNATIONAL CODE OF SIGNALS.

The new International Code of Signals consists of two volumes.

Volume I. relates to Visual and Sound Signalling.

Volume II. relates to Radio Signalling.

The flags have been added to and in some places altered from the old Code.

There is a flag for each letter of the alphabet and with the exceptions of *A* and *B* (which are burgees) are all square flags.

There are 10 numeral pendants, 3 substitute flags and the answering pendant, making a total of 40 in all.

Distant signals and fixed semaphore signals are abandoned.

INSTRUCTIONS ON SIGNALLING.

1. **Visual signalling** is any method of above-water signalling capable of being seen.
2. **Sound signalling** is any method of Morse signals by means of siren, whistle, fog horn, bell, or other sound apparatus.
3. **Message** applies to any communication sent either by land telegraph, sound signalling, visual signalling, radiotelegraphy or radiotelephony.
4. **Coded message.**—A message in which the text consists of figures or letters in place of ordinary words.
5. **Plain language.**—A message whose meaning is intelligible without the assistance of a decode.
6. **Originator** is the authority who orders a message to be sent.
7. **Ship (or station) of origin** is that ship (or station) where the originator hands in a message for transmission, irrespective of the method of communication employed.

8. **Transmitting ship (or station)** is the ship (or station) by which a message is actually being made.
9. **Addressee** is the authority to whom a message is addressed.
10. **Ship (or station) of destination** is that ship (or station) in which the message is finally received by the addressee.
11. **Receiving ship (or station)** is the ship (or station) by which a message is actually being read.
12. **Procedure** denotes the rules drawn up for the conduct of signalling.
13. **Procedure signal** is a signal designed to facilitate the conduct of signalling.
14. **Time of origin** is the time at which a message is ordered to be made.
15. **Time of dispatch** is the time at which the transmitting ship completes the transmission of the message.
16. **Time of receipt** is the time at which the receiving ship completes the reception of the message.
17. **Group** denotes one or more contiguous letters and/or numerals which in themselves compose a separate signal.
18. **Numeral group** consists of one or more numerals.
19. **Hoist** consists of one or more groups displayed from a single halyard.
20. **At the dip.**—A signal is said to be at the dip when it is hoisted about half the full extent of the halyards.
21. **Close up.**—A signal is said to be close up when it is hoisted to the full extent of the halyards.
22. **Tackline** is a length of halyard about 6 feet long used to separate each group of flags, which, if not so separated, would convey a different meaning to that intended.
23. **Bearings** made by a ship pointing out an object or referring to a position are always reckoned *from* the ship making the signal or from the point of departure, that is *invariably toward the objective.*

24. **Bearings and courses** may be either true or magnetic, but will always be true unless otherwise stated.
25. **Bearing signal** consists of a numeral group preceded by the letter "*X.*"
26. **Relative bearing** is the direction with reference to the fore and aft line of the ship *from* which the bearing is taken; it may be measured in degrees or points from the bow to the stern on either side.
27. **Course signal** consists of a numeral group preceded by an appropriate group from the Code.
28. **Time signal** consists of a numeral group preceded by the letter "*T.*"
29. **Position signal** consists of a numeral group preceded by the letter "*P.*"
30. **Signal letters** are the letters assigned to a ship or aircraft for the purposes of identification.

It is to be carefully noted that throughout these explanations the term "Ship" includes aircraft, whether on the water or in the air, except where otherwise specified. The rules and procedure apply to them.

METHOD OF SIGNALLING BY FLAGS.

As a general rule, only one hoist should be shown at a time, but in any case each hoist or group of hoists is to be kept flying until it has been answered by the receiving ship.

When several flag hoists are displayed simultaneously they are to be read in the following order: (*a*) masthead, (*b*) triatic stay, (*c*) starboard yardarm, (*d*) port yardarm.

When more groups than one are shown on the same halyard they must be separated by a tackline and be read in the numerical order of their superiority.

When more than one hoist is shown at the same yardarm, but on different halyards, the outboard hoist is to be read first. When

more hoists than one are shown at the triatic stay, the foremost hoist is to be read first.

A signal is said to be superior to another when hoisted before either as regards time or hoist. It is said to be inferior when it is after either in point of time or hoist.

The transmitting ship should always hoist the signal where it can be most easily seen by the receiving ship, that is, in such a position that the flags will blow out clear and be free from smoke.

HOW TO CALL.

If no signal letters are hoisted superior to the signal, it will be understood as being addressed to all ships within visual signalling distance; in all other cases the signal letters of the ship or ships addressed are to be hoisted superior to the signal.

If it is not possible to determine the signal letters of the ship to which it is desired to signal, the group (*V H*) for "You should hoist your signal letters" should be hoisted first; at the same time the ship will hoist her own signal letters. If this fails, then the group (*N M J*) for "I wish to signal to vessel or vessels (number indicated if necessary) on bearing indicated from me" must be hoisted.

HOW TO ANSWER SIGNALS.

All ships to which signals are addressed or which are indicated in signals are to hoist the answering pendant at the dip as soon as they see each hoist, and close up immediately they understand it; it is to be lowered to the dip, as soon as the hoist is hauled down in the transmitting ship, being hoisted close up again as soon as the next hoist is understood and so on until the signal is completed.

If possible, the triatic stay should not be used for the answering pendant, as it is sometimes difficult to see whether it is at the dip or close up when in this position.

HOW TO COMPLETE A SIGNAL

The transmitting ship is to hoist the answering pendant singly after the last hoist of the signal to indicate the message is completed. The receiving ship is to answer this in a similar manner to all other hoists.

HOW TO ACT WHEN SIGNALS ARE NOT UNDERSTOOD.

If the receiving ship cannot clearly distinguish the signal made to her, she is to keep the answering pendant at the dip and hoist an appropriate signal to inform the transmitting ship of the reason. Such a signal is found in the General Code.

Similarly, if she can distinguish the signal but cannot understand the purport of it, she should hoist the appropriate signal *V B*, signifying "Signal is not understood though flags are distinguished."

USE OF SUBSTITUTES.

The use of substitutes is to enable the same signal flag to be repeated one or more times in the same group while still only carrying one set of flags. By the use of three additional flags, called substitutes (named, first, second, and third substitutes respectively), any two, three, or four letter group can be hoisted by means of a single set of flags.

In the International Code of Signals, two classes of signal flags are employed, alphabetical flags and numeral pendants, a substitute can only repeat a signal flag of the same class as that immediately preceding it. It therefore follows that if a substitute immediately follows one or more alphabetical flags it represents one of those flags; similarly, if a substitute follows one or more numeral pendants it represents one of those pendants.

The answering pendant when used as a decimal point is to be disregarded in determining which substitute to use.

The first substitute always repeats the uppermost signal flag of that class of flags which immediately precede the substitute.

The second substitute always repeats the second signal flag counting from the top of that class of flags which immediately precede the substitute.

The third substitute always repeats the third signal flag counting from the top of that class of flags which immediately precede the substitute.

No substitute can ever be used more than once in the same group.

EXAMPLES ON USING SUBSTITUTE FLAGS.

1. The signal BULL would be made by signal flags as follows:
   Flag *B*
   „ *U*
   „ *L*
   Third substitute (in this case representing the third flag "*L*").

2. The signal DODD would be made by signal flags as follows:
   Flag *D*
   „ *O*
   First substitute (representing the first flag "*D*")
   Third substitute („ third flag "*D*")

3. The signal 4000 would be made by signal flags as follows:
   Numeral pendant 4
   „ 0
   Second substitute (representing the second pendant 0)
   Third substitute (representing the third pendant 0)

4. The time signal 14h. 40m. or T 1 4 4 0 would be made by signal flags as follows:
   Flag *T*
   Numeral pendant 1
   „ 4
   Second substitute (representing the second pendant 4)
   Numeral pendant 0

NOTE.—As already explained, the substitute flag can only repeat a signal flag of the same class. In this case the first flag is an alphabetical flag which is a different class from the numeral pendants following. We therefore count the first 4 as the second flag in considering which substitute flag to use.

5. The geographical signal for SUPERIOR LAKE, N. America, is *A P P P*. The flags to hoist are:
   Flag *A*
   „ *P*
   Second substitute (representing *P*)
   Third substitute („ *P*)

HOISTS OF FLAGS.

Signals may consist of 1, 2, 3, or 4 flags.

In certain cases, *i.e.* those relating to *Time* and *Position*, they may consist of 5, 6 or 7 flags.

One flag signals are those that are **Urgent or of very common use.**

A	I am undergoing a full speed trial
B	I am taking in or discharging explosives
C	Yes (Affirmative)
D	Keep clear of me—I am manoeuvring with difficulty
E	I am altering my course to starboard
**F*	I am disabled. Communicate with me
G	I require a pilot
H	I have a pilot on board
I	I am altering my course to port
J	I am going to send a message by semaphore
**K*	You should stop your vessel instantly
**L*	You should stop. I have something important to communicate
M	I have a doctor on board

Only those marked with an asterisk should be used by flashing.

N No (Negative)
**O* Man overboard
P* **In harbour (Blue Peter)—All persons are to repair on board as the vessel is about to proceed to sea. (NOTE:—To be hoisted at the foremast head)
At sea—Your lights are out or burning badly
Q My vessel is healthy and I request free pratique
**R* The way is off my ship; you may feel your way past me
S My engines are going full speed astern
T Do not pass ahead of me
**U* You are standing into danger
**V* I require assistance
**W* I require medical assistance
X Stop carrying out your intentions and watch for my signals
Y I am carrying mails
**Z* To be used to address or call shore stations

Only those marked with an asterisk should be used by flashing.

APPENDIX D.

TOWING SIGNALS.

To be used only when towing and being towed.

These signals are to be made—

By Day.—A single flag, which may be exhibited by being held in the hand or by hoisting at the stay or fore shrouds or at the gaff, according to circumstances.

By Night.—By flashing, care being taken not to confuse other ships.

Two-Letter Signals or Two-Flag Signals.

Two letter signals have been allocated to significations which follow next in importance and consist mostly of distress and

manoeuvring signals, with the addition of a few general signals of common use.

They commence at *A C* and end at *Z N*.

Three-Flag Signals.

Signals relating to points of the compass.

Signals relating to points on the bow, beam or quarter.

These are *relative bearing signals.*

Standard Times.

These signals relate to Standard and Zone times of different localities.

Model Verb Signals.

These signals relate to auxiliary phrases such as "I have," "They did," "Have we," etc.

Punctuation and Amplifying Phrases.

These signals govern the sense of a succeeding signal and alter its sense, and may alter a definite statement into a question.

General Code.

These signals (by far the most numerous) relate to all other words, phrases and sentences, and is the Code to turn to so as to find the sense of practically all signals.

Decode Signals.

These signals contain many common phrases and can be found in the General Code also, in light type to the right hand side of their meaning.

Four-Flag Signals.

Consist of geographical signals which all have the flag *A* uppermost.

In these signals both the flags and also the places are alphabetically arranged. It therefore consists of one table and not as two as in the previous editions and certainly makes coding and decoding very simple.

Bearing signals are four-flag signals, *X* being the top flag.

Names of ships are four-flag signals, *G* being the top flag for British ships; possibly *M* will be the top flag.

APPENDIX B.

PILOT SIGNALS.

The following signals, used or displayed together or separately, shall be deemed to be signals for a pilot:—

In the Daytime.

1. The International Code Signal *G* signifying "I require a pilot."
2. The International Code Signal *P T* signifying "I require a pilot."
3. The Pilot Jack hoisted at the fore.

At Night.

1. The pyrotechnic light, commonly known as a blue light, every 15 minutes.
2. A bright white light, flashed or shown at short or frequent intervals just above the bulwarks for about a minute at a time.
3. The International Code Signal *P T* by flashing.

APPENDIX C.

QUARANTINE SIGNALS.

The following signals are to be shown by vessels requiring or required to show their state of health:—

In the Daytime.

Q flag—signifying - -	"My ship is 'healthy' and I request free pratique."
Q flag over first substitute (*Q Q*)—signifying - -	"My ship is 'Suspect,' *i.e.*, I have had cases of infectious diseases more than five days ago, or there has been unusual mortality among the rats on board my ship."
Q flag over *L* (*Q L*)—signifying	"My ship is 'Infected,' *i.e.* I have had cases of infectious diseases less than 5 days ago.

By Night.

Red light over a white light—signifying - - -	"I have not received free pratique."

(Only to be exhibited within the precincts of a port. The lights should not be more than 6 ft. apart.)

HOW TO SPELL.

Names in the text of a message which is being signalled by flags are to be spelt out by means of the alphabetical signals which consist of—

Signal	Meaning
Answering pendant over *E* (Alphabetical signal No. 1)	Indicates that until alphabetical signal No. 3 is made the letters following do not represent signals from the Code, but represent the letters of the alphabet spelling a word.

Signal	*Meaning*
Answering pendant over *F* (Alphabetical signal No. 2)	Indicates the end of a word or dot between initials.
Answering pendant over *G* (Alphabetical signal No. 3)	Indicates the spelling of the words is completed, and that the signals that follow are to be looked up in the Code in the usual manner.

Example—Required to signal "Russell Cook."

Signal—

1st group	Answering pendant *E*	= Spelling follows
2nd ,,	*R U S* third substitute	= *R U S S*
3rd ,,	*E L* second substitute	= *E L L*
4th ,,	Answering pendant *F*	= End of word
5th ,,	*C O* second substitute *K*	= *C O O K*
6th ,,	Answering pendant *G*	= End of spelling

How to Express Ships' Names.

Ships' names in the text of coded messages are to be expressed by means of their signal letters, and are to be spelt out when the message is made in plain language.

How to Signal Numbers.

By the numeral pendants of the Code, which being pendant-shaped do not require any signal to signify they are numbers.

The decimal point between numerals is indicated by the answering pendant.

How to Signal Times.

Time is expressed in four figures in which the first two represent the hours (from 00=midnight up to 23=11 p.m.), and the last two represent the minutes from (00 to 59).

When signalling time in coded messages the four figures indicating hours and minutes are to be signalled by four numerals

preceded by and joined with the letter *T* to form a single group. For example :—*T* 2 1 3 6.

How to Signal Courses and Bearings.

Courses and bearings are to be expressed in three figures denoting degrees from 000 to 359 measured clockwise, and are always to be true, *unless expressly stated to be otherwise in the context.*

When signalling courses in coded messages the three figures indicating degrees are to be signalled by a group consisting of three numerals preceded by an appropriate group from the Code.

In the case of bearings the three figures indicating degrees are preceded by, but joined with, the letter *X* to form a single group.

For example:—My present course is 176 (true)
Signal *E B X* 176

For example:—Bearing 189 (true)
Signal *X* 189

How to Signal Positions.

When signalling latitude and longitude, each of the two groups indicating the degrees and minutes of latitude and longitude are to be signalled by four numerals preceded by and joined with the letter *P*.

As in most circumstances the receiver will know whether the latitude is North or South and the longitude is East or West, it will not be indicated. Should, however, the latitude be near the Equator or the longitude close to the meridians of 0° or 180° the letter *N* or *S* is to be added immediately after the latitude group, to denote North or South respectively, and the letter *E* or *W* immediately after the longitude group to denote East or West respectively.

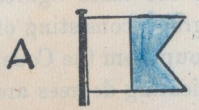
To retain the form of a four-figure group, when the longitude is more than 99°, the figure indicating the number of hundreds of

degrees will usually be omitted. As a rule, no difficulty will arise as two ships exchanging signals must know their own longitude within the nearest hundred degrees.

In very exceptional cases the five figures may be used.

EXAMPLES OF THE VARIOUS HOISTS.

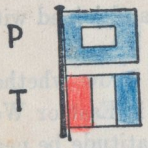
One-Flag Signals.



I am undergoing a speed trial.

Two-Flag Signals.

I must abandon my vessel.



I require a pilot.

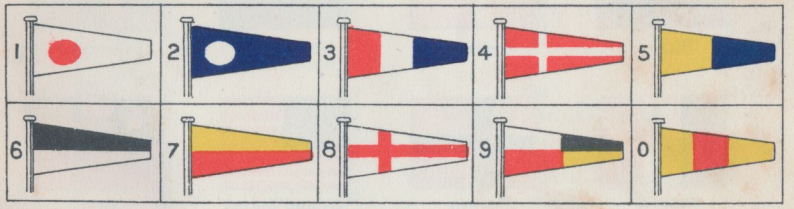
Standing for

Q
Q

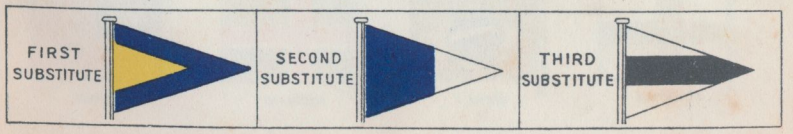
My ship is "Suspect," *i.e.* I have had cases of infectious diseases more than five days ago, or there has been unusual mortality among the rats on board my ship.

INTERNATIONAL CODE OF SIGNALS

NUMERAL PENDANTS.



SUBSTITUTES.



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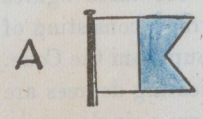
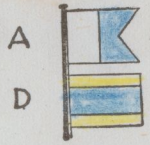
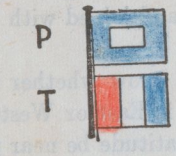


I am undergoing a speed trial.

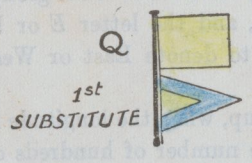
Two-Flag Signals.



I must abandon my vessel.



I require a pilot.



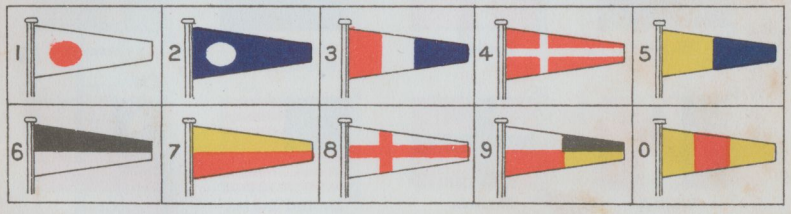
Standing for

Q
Q

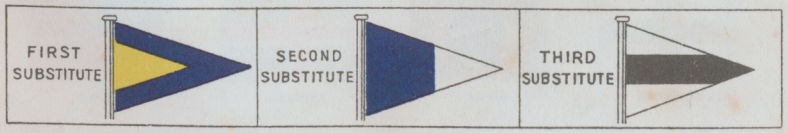
My ship is "Suspect," *i.e.* I have had cases of infectious diseases more than five days ago, or there has been unusual mortality among the rats on board my ship.

INTERNATIONAL CODE OF SIGNALS

NUMERAL PENDANTS.

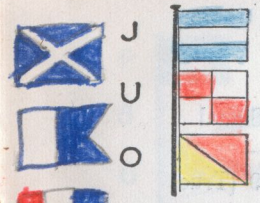


SUBSTITUTES.



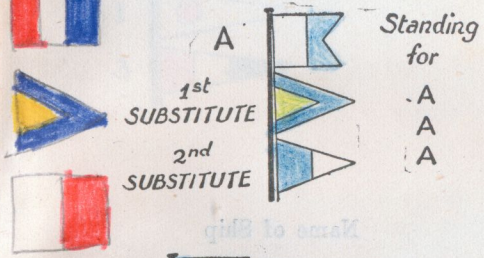
NATIONAL COLOURS

Three-Flag Signals.



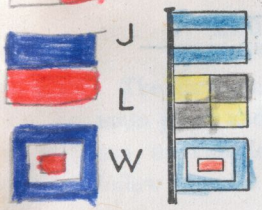
Points of Compass

N.E. by N.



Relative Bearings

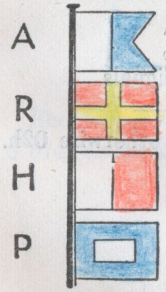
1 point on the port bow.



General Code

You should make a running moor.

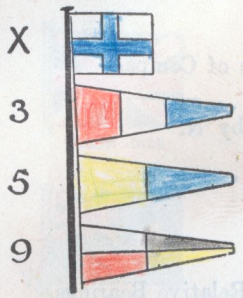
Four-Flag Signals



Geographical Signal

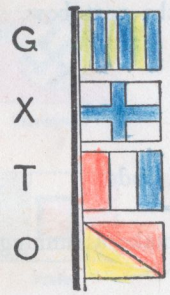
Wellington, New Zealand

Four-Flag Signals (*Continued*).



Bearing Signal

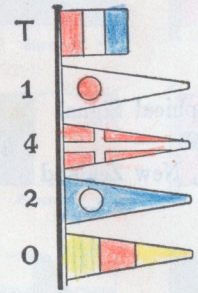
Bearing 359 (True)



Name of Ship

Example Ship———

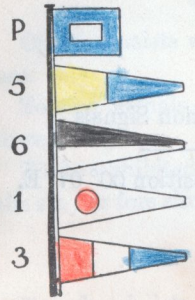
Five-Flag Signals:



Time Signals

Meaning 1420 otherwise 02h. 20m. P.M.

Five-Flag Signals (*Continued*).



Position Signal

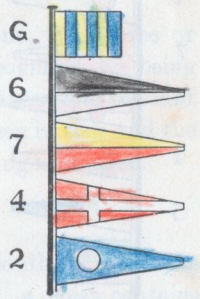
Meaning 56° 13′

REGISTRATION LETTERS OF AN AIRSHIP.

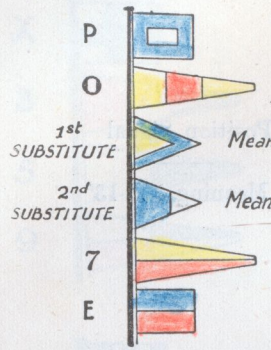
The distinguishing marks of all aircraft are painted on the lower main plane and also on each side of the fuselage. It consists of one or two letters indicating the nationality, and numbers follow to make five symbols in all.

G or *M* are the letters allotted to Great Britain.

Should you wish to call an aircraft having *G* 6742 as her signal letters you would hoist



Six-Flag Signals



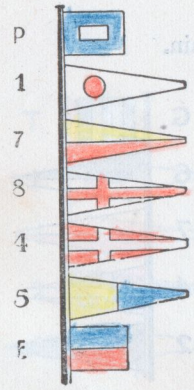
Position Signals

Meaning Position 00° 07′ E.

Seven-Flag Signal

In an extreme case in signalling a longitude signal, and wishing to indicate the hundreds of degrees and also East or West, you would use seven flags.

Example.—To make Longitude 178° 45′ E.



Meaning Position 178° 45′ E.

RESUME OF THE VARIOUS HOISTS OF SIGNAL FLAGS

Signals made by One Flag.

One-flag hoists which are either very urgent or of very common use.

Towing signals.—Between towing vessels and vessels being towed.

To be exhibited by being held in the hand or by hoisting at the stay or fore shrouds, or at the gaff according to circumstances.

Signals made by Two Flags.

Two-flag hoists consist mostly of distress and manoeuvring signals, with the addition of a few general signals of common use.

Signals made by Three Flags.

Three-flag hoists include Points of Compass, Relative Bearings, Standard Times, Verbs, Punctuation and Amplifying Phrases, and the General Code and Decode.

Signals made by Four Flags.

Four-flag signals include Geographical Signals, Names of Ships, Bearings.

Signals made by Five Flags.

Those relating to time and position.

Alphabetical spelling signals may contain one, two, three or four flags in one hoist. They are always recognised by being preceded by the answering pendant over *E*, the answering pendant over *F* being the end of a word or the dot between initials and the answering pendant over *G* to indicate that spelling is finished.

Signals made by Six Flags.

When it is necessary to indicate North or South in a latitude signal, or East or West in a longitude signal, a hoist contains

six flags, *e.g.* *P* 0008 N., *P* 0 0 0 4 E., which mean Position 00° 08′ N. Lat., Position 00° 04′ E. Long.

When it is *necessary* to indicate a signal containing 100° or more it will become a seven-flag signal.

On the Use of the Answering Pendant.

In answering a signal, the answering pendant is to be hoisted to the dip as soon as a hoist is seen, and close up immediately the signal is understood. It is to be hauled down to the dip between each hoist from the signalling ship.

The transmitting ship will hoist the answering pendant singly after the last hoist of signals to indicate that the message is completed.

The receiving ship answers this by hoisting the answering pendant close up.

The answering pendant is used to make the decimal point in signalling numbers.

The answering pendant is used in combination with *E*, *F* and *G* when spelling words.

It is hoisted by a man-of-war when she wishes to communicate with a merchant vessel, and she will keep it flying in a conspicuous position during the whole time the signal is being made.

As soon as the semaphore flag (*J*) is hoisted the answering pendant is to be hoisted at the dip by the ship addressed, and hoisted close up when ready to read.

EXAMPLES FOR PRACTICE.

Required to make the signal "man overboard."

This is evidently a very important signal and could be looked up straight away in the one-flag signals. At the same time as all the one-flag signals are given in the General Code in alphabetical order, we might turn to the most important word (overboard) and the same signal is found. It is the one-flag signal letter "*O*."

Reading the signal, the receiver would turn to the table of one-flag signals for the meaning.

Required to make the signal, "It is dangerous to proceed without pilot."

Turn to the General Code for the most important word. In this case we will consider it is "pilot." Among the signals relating to pilot we find the two-flag signal "*S M*."

Receiving the signal, we should turn to the two-flag signals for the meaning.

It will be of interest here to explain how the above signal, which is a statement, can be changed into the question, "Is it dangerous to proceed without a pilot?"

We therefore make use of the "Table of Amplifying Phrases" and hoist the signal *A G W*, meaning the "Group which follows is a question;" then hoist *S M*, which means "*Is it* dangerous to proceed without a pilot?"

Required to make "You should report me all well in Lat. 54° 30′ N., Long. 20° 45′ W."

Turn to the General Code for the most important word; in this case it is "report." Looking down the page we find the signal *M I N* and its meaning, "You should report me all well," and (in italics) *in position indicated.*

Next we know that the flag *P* as first flag in a hoist stands for "position," so *P* 5430 is hoisted meaning 54° 30′; then hoist *P* 2045 meaning 20° 45′.

As the receiving ship must know the latitude is North and the longitude is West, there is no need to indicate them by the letters *N* and *W*.

Required to make "I expect to arrive at 2000 (or 8 p.m.) on Saturday."

Turn to the General Code for the most important word; in this case it is "arrive." We find the signal *B I S* and its meaning

"I, or vessel, indicated, expect,s to arrive, at, on." It therefore fits the signal to be made, *i.e.* "I expect to arrive at." Next we know that flag *T* stands for time and we therefore hoist *T* 2000; the next and last hoist *M W H* meaning "Saturday" being found in the General Code in its alphabetical order.

Notice here that the signal 2000 will be made by using the numeral pendants for 2 and 0, the second substitute flag and the third substitute flag.

Required to make the number 94·6.

Hoist the numeral pendants 94 (answering pendant to indicate the decimal point), and the numeral pendant 6, all in one hoist.

Required to make the signal for the name Martin Rookwood, by Alphabetical Spelling Signals.

1st hoist—Answering pendant over *E*, meaning that all flags that follow have their alphabetical meaning.
2nd hoist—Flags *M A R*
3rd „ Flags *T I N*
4th „ Answering pendant over *F*, signifying end of word
5th „ Flags *R O* second substitute *K*
6th „ Flags *W O* second substitute *D*
7th „ Answering pendant over *G* signifying the end of spelling signals

HOW THE "INTERNATIONAL CODE OF SIGNALS" VOLUME I. IS ARRANGED.

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MORSE SIGNALLING

When using the International Morse Code the symbols representing the letters, numerals, signs, etc., are expressed by two elements called a dot (or a short) and a dash (or a long), which are signalled either singly or in combination. Whatever means are employed in signalling the Morse Code, the dots and dashes and spaces between them should be made to bear the following ratio:

1. A dot is taken as one unit.
2. A dash is equivalent to three units.
3. The space of time taken between any two elements of a symbol is one unit, and between two symbols is equal to three units.
4. The space of time between two words or groups is equal to five units.

It does not matter at what speed the signal is being made these ratios must be maintained.

It also should be observed that whether flashing or sound signals are being made it is better to err on the side of making the dots shorter in their proportion to the dashes.

Morse signals may be made by:

1. When flashing, by exposing and obscuring a light.
2. When sound signalling, by long or short blasts on the whistle, syren, fog-horn or any other sound apparatus.

The standard rate of signalling by flashing in the Morse Code is 8 words per minute.

INTERNATIONAL MORSE CODE.

Alphabet.

Meaning	Symbol	Meaning	Symbol	Meaning	Symbol
A	·—	*H*	····	*Q*	——·—
ä	·—·—	*I*	··	*R*	·—·
à	·——·—	*J*	·———	*S*	···
B	—···	*K*	—·—	*T*	—
C	—·—·	*L*	·—··	*U*	··—
CH	————	*M*	——	ü	··——
D	—··	*N*	—·	*V*	···—
E	·	ñ	——·——	*W*	·——
è	··—··	*O*	———	*X*	—··—
F	··—·	ö	———·	*Y*	—·——
G	——·	*P*	·——·	*Z*	——··

Numerals.

Meaning	Symbol
1	·————
2	··———
3	···——
4	····—
5	·····
6	—····
7	——···
8	———··
9	————·
0	—————

Punctuation.

Meaning	Sign	Symbol
Full stop (.) and decimal point	*III*	·· ·· ··
Bar indicating fraction (/)	$\overline{X\,E}$	—··—·

In all signs, such as the above $\overline{X\,E}$, with a bar over the letters, the whole symbol is made without breaking the letters up, *i.e.* made as one continuous symbol.

Procedure Signals and Signs.

Meaning	Sign	Symbol
Call for unknown ship and general call	*A A A A*, etc.	·— ·— ·— ·— etc.
Answering sign	$\overline{TTTTTT}$, etc.	— — — — —, etc.
Space sign	*I I*	·· ··
Break sign	$\overline{BT}$	— ··· —
Erase sign	$\overline{EEEEEEEE}$, etc	·····, etc.
Repeat sign	$\overline{UD}$	··— —··
All after (Used when obtaining a repetition.)	*A A*	·— ·—
All before (Used when obtaining a repetition.)	*A B*	·— —···
Word or group after (Used when obtaining a repetition.)	*W A*	·— — ·—
Word or group before (Used when obtaining a repetition.)	*W B*	·— — —···
Ending sign	$\overline{AR}$	·— ·— ·
From	*De*	—·· ·
You are correct	*C*	—·—·
Repeat back	*G*	— —·
Message received	*R*	·—·
Word (plain language) received	*T*	—
I am unable to read your message owing to light not being properly trained or light burning badly	*W*	·— —
Intern'l Code group follows	*P R B*	·— —· ·—· —···

THE USE OF PROCEDURE SIGNALS AND SIGNS.

Procedure signals and signs enable ships to exchange short concise messages used in connection with signalling.

To Call an unknown Ship and General Call.

Make the signal *A A A A*, etc., and continue to make it until the ship addressed answers.

Answering Sign.

The answering sign $\overline{TTTTTT}$, etc., is used to answer the call sign, and is continued to be made until the transmitting ship ceases to make the call sign.

T

The letter *T* is made to indicate the receipt of each *word* in the text of a *plain language message.*

R

The letter *R* is made to indicate that the message is received.

G

The letter *G* signifies "Repeat back." It may be inserted at the beginning of a plain language message and is signalled separately. When thus used it signifies: "Everything which follows in this message is to be repeated back, word by word, as soon as received."

C

The letter *C* means "You are correct."

When a word, or group, in the *text* of a message, is repeated

back the letter "*C*" is used by the transmitting ship to indicate to the receiving ship that the repetition has been made correctly.

De

The word "*De*" used in the identity signifies "From."

W

The letter *W* used as a message in itself signifies: "I am unable to read your message owing to light not being properly trained or light burning badly." This is to be made by the receiving ship at any stage of the message, if required, and is to be answered by the transmitting ship showing a steady light until the receiving ship is satisfied with the light and ceases to make *W*.

Space Sign.

The space sign *I I* is used to separate the signs *A A*, *A B*, *W A* and *W B* from the identifying words or groups which follow them. It is also used to separate whole numbers from fractions.

Break Sign.

The break sign $\overline{B\,T}$ is used to precede the text. It is to be repeated back, but its repetition by the receiving ship is not acknowledged with "*C*" by the transmitting ship.

Erase Sign.

The erase sign $\overline{E\,E\,E\,E\,E\,E}$, etc., is used to indicate that the last word or group was signalled incorrectly. It is to be answered with the erase sign. When answered, the transmitting ship will repeat the last word or group which was correctly signalled and then proceed with the remainder of the message.

If the mistake is not discovered until after the message has been completely signalled, a new message must be made.

If it is desired to cancel the whole of a message while in process of transmission the erase sign must be made followed by the ending sign, namely, $\overline{E\,E\,E\,E\,E\,E}$ $\overline{A\,R}$.

Repeat Sign.

The repeat sign $\overline{U\,D}$ is used to obtain a repetition of the whole or part of a message.

Made singly it signifies: "Repeat *the last* message." In sound signalling it means "I missed the last word (or group), please go back a few words (or groups) and continue the message."

The repeat sign is also used in conjunction with the signs *A A*, *A B*, *W A*, or *W B*, and an identifying word or group, the last two being separated by the space sign.

Example—

$\overline{U\,D}$ *A A* *I I*	PILOT	signifies:	"Repeat *all after* the word PILOT."
$\overline{U\,D}$ *A B* *I I*	Orders	„	"Repeat *all before the word* ORDERS."
$\overline{U\,D}$ *W A* *I I*	SHOULD	„	"Repeat the *word after* SHOULD."
$\overline{U\,D}$ *W B* *I I*	PEOPLE	„	"Repeat the *word before* PEOPLE."

If a message is not understood, or if a coded message, when decoded, is not intelligible the repeat sign is *not* used. The receiving ship must then make the appropriate signal from the Signal Code, such as *J G N*, "Your message is *not* understood."

Ending Sign.

The ending sign $\overline{A\,R}$ is used in all cases to end a message.

International Code Group Indicator P R B.

Messages sent by Code must be preceded by *P R B* to signify that the message is *not* in plain language.

Special Note.—In acknowledging the receipt of each word in a plain language message the letter *T* is made. In acknowledging any *coded group* you must repeat back the same coded group. If the repetition is correctly made the transmitting ship will make "*C*," but if incorrect she will make the group again.

EXAMPLES IN FLASHING SIGNALLING.

In these examples it must be understood that the ship in the left hand column always signals first unless otherwise indicated by the direction of an arrow.

1. Simple Plain Language Message.

The master of the SS..... wishes to ask a passing vessel "What monsoon have you experienced?"

The other vessel is the SS.....

Component	SS..... makes	SS..... makes
Call	*A A A A A A*, etc.	$\overline{TTTTTT}$, etc.
Identity	*De*	*De*
	←	
Break sign	$\overline{B\ T}$	$\overline{B\ T}$
Text	What	*T*
	monsoon	*T*
	have	*T*
	you	*T*
	experienced	*T*
Ending	$\overline{A\ R}$	*R*

2. Coded Message.

A case when it is not necessary to establish the identity of the ships. A vessel wishes to make "You should send life-boat to take off crew," the coded group for which is *Q F*.

Component	Transmitting ship makes	Receiving ship makes
Call	*A A A A A A*, etc.	$\overline{TTTTTT}$, etc.
Break sign	$\overline{B\ T}$	$\overline{B\ T}$
Text	*P R B* (Meaning Message that follows is in Code.)	*P R B*
	C	
	Q F	*Q F*
	C	
Ending	$\overline{A\ R}$	*R*

3. Example of Repetition of "All before" a Certain Word.

Ship A has sent the message "Passed floating mine in position *P* 50° 30′, *P* 20° 45′"

Ship B requires a repetition of all before the word "position."

As these ships have already been signalling they have obtained the identities; it is therefore not necessary to establish them again.

Procedure.—

Component	Ship B makes	Ship A makes
Call	Ship A's numbers	$\overline{TTTTT}$, etc.
Identity	*De* Ship *B*'s numbers	*De* Ship B's number
Text	$\overline{U\ D}$ *A B II* position	$\overline{U\ D}$ *A B II* position
	C	
Ending	$\overline{A\ R}$	*R*

Ship A then repeats the message up to and including the word "position."

Component	Ship A makes	Ship B makes
Call	Ship B's numbers	$\overline{TTTTT}$, etc.
Identity	*De* Ship A's numbers	*De* Ship A's numbers
Break sign	$\overline{B\,T}$	$\overline{B\,T}$
Text	Passed	*T*
	floating	*T*
	mine	*T*
	in	*T*
	position	*T*
Ending	$\overline{A\,R}$	*R*

SIGNALLING BY SOUND.

Sound signalling should be used with discretion. It is a very slow method and may create confusion if used in crowded waters.

To signal by sound the procedure is as follows:

The transmitting ship will make the "Call" in the same way that it is made by flashing.

NOTE.—No call or answer will be made when transmitting single letter signals.

The receiving ship answers with the answering sign.

The transmitting ship proceeds to signal the message right through.

The receiving ship does not answer unless she misses a word or group, but waits until the ending $\overline{A\,R}$ has been made and then makes *R*.

Should the receiving ship miss a word or group, she is immediately to make the repeat sign $\overline{U\,D}$, on hearing which the transmitting ship will cease signalling and then go back a few words or groups and continue the message.

SIGNALLING BY SEMAPHORE.

Semaphore signals are made either by means of a mechanical semaphore or by means of a signalman holding a pair of flags in his hands and forming the letters and signs with his arms.

Great care is necessary to form the letters and signs very accurately.

The standard rate of signalling by semaphore is to be regarded as 8 words per minute.

The semaphore flag (*J*) hoisted either singly or inferior to a group of signal letters indicates that a communication is to be made by semaphore. It is to be hoisted where most convenient and where best seen.

As soon as the semaphore flag (*J*) is observed, the answering pendant is to be hoisted at the dip by the ship (or ships) addressed, and hoisted close up when they are ready to read.

In case of doubt as to which vessel is intended to answer the signal, the semaphore flag (*J*) will be hoisted with a tackline inferior to the signal letters of that ship.

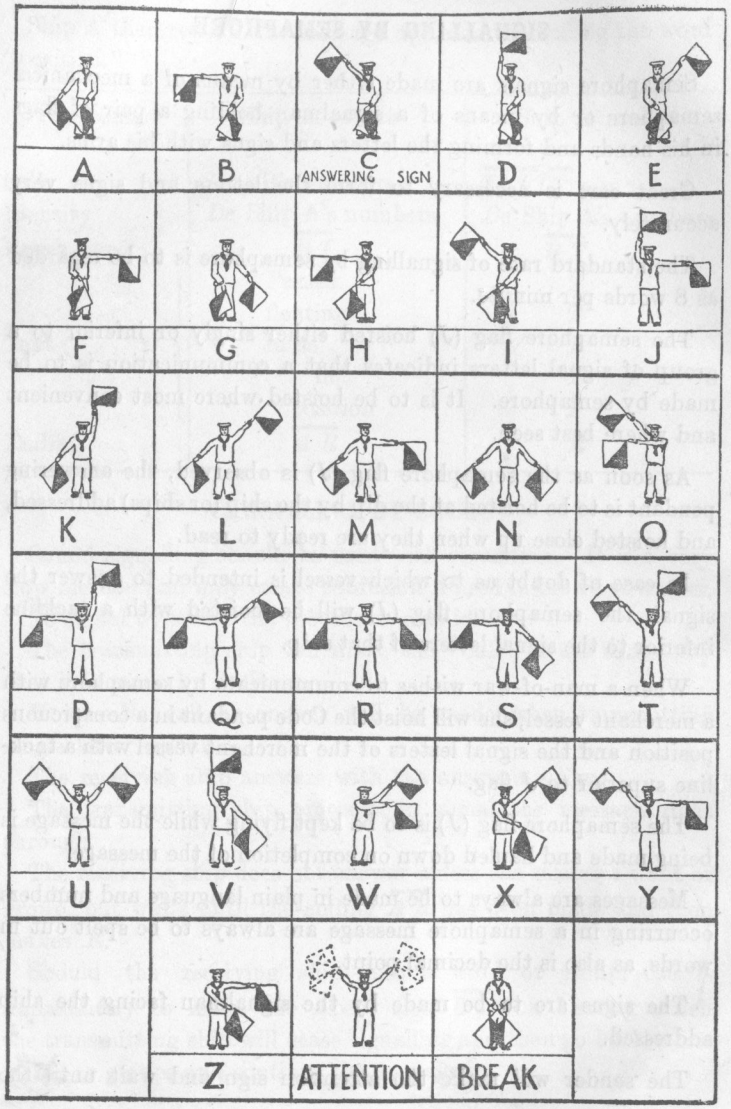
When a man-of-war wishes to communicate by semaphore with a merchant vessel, she will hoist the Code pendant in a conspicuous position and the signal letters of the merchant vessel with a tackline superior to *J* flag.

The semaphore flag (*J*) is to be kept flying while the message is being made and hauled down on completion of the message.

Messages are always to be made in plain language and numbers occurring in a semaphore message are always to be spelt out in words, as also is the decimal point.

The signs are to be made by the signalman facing the ship addressed.

The sender will make the attention sign and wait until the



answering pendant is hoisted up by the ship addressed, then wait a reasonable pause before commencing to transmit.

If the ships are close together the attention sign and answering sign may be used instead of hoisting the semaphore flag and answering pendant.

At the end of each word the arms are to be dropped to the break position. When double letters occur, the arms are to be dropped to the break position after the first letter is made, and then moved out to the second letter without pausing.

The reception of each word is to be acknowledged by the receiver making the letter "C." If this letter is not made the word is to be repeated.

Should an error be made, a succession of *E*'s ($\overline{EEEEE}$, etc.) must be sent and then followed by the last word transmitted correctly and the message continued.

All messages will end with the ending sign $\overline{A\,R}$.

VOLUME II.

FOR RADIO SIGNALLING.

Radio signalling (at present) does not form a part of the Syllabus of Examination for Masters and Mates, therefore it is not necessary to devote much space to it.

The governing rules relating to it are practically the same as for flag signalling in Volume I.

The symbols for any coded group consist of five symbols excepting ships' names which keep the same four letters as in flag signalling.

When signalling from the "International Code of Signals" the Code group "*I N T C O*" signifying " The following is coded

by the International Code of Signals" is to be inserted as the first word of the text.

The arrangement of the book is very similar to Volume I., consisting of General Instructions, Examples, then Three Tables for Correcting Mutilated Signals, Model Verbs, Punctuation and Amplifying Phrases, General Code, Numbers, Dates, Degrees, Points of Compass, Relative Bearings, Degrees of Latitude, Degrees of Longitude, Minutes and Seconds, Standard Times, Barometer and Thermometer Readings, Medical Section, Geographical, and the Decode.

GENERAL NOTICES.

The 1931 International Code of Signals.

This International Code of Signals comes into voluntary use for British vessels on the 1st January, 1933.

From 1st January, 1933, until it is in general use internationally, presumably a year later, this new Code and the old Code will be used concurrently by British ships, the use of this new Code being denoted by the hoisting of the Code Pennant with the fly tied to the halyards.

After this new Code is brought into international use, the new Code will alone be used, and its distinguishing sign will thenceforward be the Code Pendant hoisted in the ordinary way.—22*nd July* (23/83).

SECTION III.

RULE OF THE ROAD AT SEA

FOR

STEAM AND SAILING SHIPS

REGULATIONS
FOR PREVENTING COLLISIONS AT SEA.

1. ORDER IN COUNCIL OF 13TH OCTOBER, 1910.

PRELIMINARY.

These Rules shall be followed by all vessels upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

In the following Rules every steam vessel which is under sail and not under steam is to be considered a sailing vessel, and every vessel under steam, whether under sail or not, is to be considered a steam vessel.

The word "steam vessel" shall include any vessel propelled by machinery.

A vessel is "under way" within the meaning of these Rules, when she is not at anchor, or made fast to the shore, or aground.

Rules Concerning Lights, Etc.

The word "visible" in these Rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

Lights.

ART. 1.—The Rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Lights for Steam Ships.

ART. 2.—A steam vessel when under way shall carry—

(*a*) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than 20 feet, and if the breadth of the vessel exceeds 20 feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than 40 feet, A BRIGHT WHITE LIGHT so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, viz., from right ahead to 2 points abaft the beam on either side, and of such a character as to be visible at a distance of at least 5 miles.

(*b*) On the starboard side a GREEN LIGHT so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least 2 miles.

(*c*) On the port side A RED LIGHT so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side, and of such a character as to be visible at a distance of at least 2 miles.

(*d*) The said green and red side-lights shall be fitted with INBOARD SCREENS projecting at least 3 feet forward from the light, so as to prevent these lights from being seen across the bow.

(*e*) A steam vessel when under way may carry AN ADDITIONAL WHITE LIGHT similar in construction to the light mentioned in sub-division (*a*). These two lights shall be so placed in line with the keel that one shall be at least 15 feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Lights for Steam Tugs and Vessels Towing.

ART. 3.—A steam vessel when towing another vessel shall, in addition to her side-lights, carry TWO BRIGHT WHITE LIGHTS in a vertical line one over the other, not less than 6 feet apart, and when towing more than one vessel shall carry AN ADDITIONAL BRIGHT WHITE LIGHT 6 feet above or below such lights, if the length of the tow, measuring from the stern of the towing vessel to the stern of the last vessel towed, exceeds 600 feet. Each of these lights shall be of the same construction and character and shall be carried in the same position as the white light mentioned in Article 2 (*a*), except the additional light, which may be carried at a height of not less than 14 feet above the hull.

Such steam vessel may carry A SMALL WHITE LIGHT abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Lights for Vessels not under Command and Cable Ships.

ART. 4.—(*a*) A VESSEL which from any accident is NOT UNDER COMMAND shall carry at the same height as the white light mentioned in Article 2 (*a*), where they can best be seen, and, if a steam vessel, in lieu of that light, TWO RED LIGHTS, in a vertical line one over the other, not less than 6 feet apart, and of such a character as to be visible all round the horizon at a distance of at least 2 miles; and shall BY DAY carry in a vertical line one over the other, not less than 6 feet apart, where they can best be seen, TWO BLACK BALLS OR SHAPES, each 2 feet in diameter.

(*b*) A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as the white light mentioned in Article 2 (*a*), and, if a steam vessel, in lieu of that light, THREE LIGHTS in a vertical line one over the other, not less than 6 feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all round the horizon, at a distance of at least 2 miles. BY DAY she shall carry in a vertical line one over the other, not less than 6 feet apart, where they can best be seen, THREE SHAPES not less than 2 feet in diameter, of which the HIGHEST AND LOWEST shall be GLOBULAR in shape and RED in colour, and the MIDDLE ONE DIAMOND in shape and WHITE.

(*c*) The vessels referred to in this Article, when not making

way through the water, shall not carry the side-lights, but when making way shall carry them.

(*d*) The lights and shapes required to be shown by this Article are to be taken by other vessels as signals that the vessel showing them is not under command and cannot therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in Article 31.

Lights for Sailing Vessels and Vessels being Towed

ART. 5.—A SAILING VESSEL under way, and ANY VESSEL BEING TOWED, shall carry the same lights as are prescribed by Article 2 for a steam vessel under way, with the exception of the WHITE LIGHTS mentioned therein, WHICH THEY SHALL NEVER CARRY.

Lights for Small Vessels during Bad Weather.

ART. 6.—Whenever, as in the case of small vessels under way during bad weather, the green and red side-lights cannot be fixed, these lights shall be KEPT AT HAND LIGHTED and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than 2 points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the colour of the light they respectively contain, and shall be provided with proper screens.

Lights for Small Steam Vessels, or Vessels under Oars.

ART. 7.—Steam vessels of less than 40, and vessels under oars or sails of less than 20 tons, gross tonnage, respectively, and rowing boats, when under way, shall not be obliged to carry the lights mentioned in Article 2 (*a*) (*b*) and (*c*), but if they do not carry them they shall be provided with the following lights:—

1. Steam vessels of less than 40 tons shall carry—

   (*a*) In the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the gunwale of not less than 9 feet, A BRIGHT WHITE LIGHT constructed and fixed as prescribed in Article 2 (*a*), and of such a character as to be visible at a distance of at least 2 miles.

   (*b*) GREEN AND RED side-lights constructed and fixed as prescribed in Article 2 (*b*) and (*c*), and of such a character as to be visible at a distance of at least 1 mile, or a COMBINED LANTERN showing a green light and a red light from right ahead to 2 points abaft the beam on their respective sides. Such lantern shall be carried not less than 3 feet below the white light.

2. Small steamboats, such as are carried by sea-going vessels, may carry the white light at a less height than 9 feet above the gunwale, but it shall be carried above the combined lantern mentioned in sub-division 1 (*b*).

3. Vessels under oars or sails, of less than 20 tons, shall have ready at hand a LANTERN WITH A GREEN GLASS ON ONE SIDE AND A RED GLASS ON THE OTHER, which on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

4. Rowing boats, whether under oars or sail, shall have ready at hand a LANTERN SHOWING A WHITE LIGHT, which shall be temporarily exhibited in sufficient time to prevent collision.

The vessels referred to in this Article shall not be obliged to carry the lights prescribed by Article 4 (*a*), and Article 11, last paragraph.

Lights for Pilot Vessels.

ART. 8.—Pilot vessels, when engaged on their station on pilotage duty, shall not show the lights required for other vessels, but shall carry A WHITE LIGHT AT THE MASTHEAD, visible all round the horizon, and shall also exhibit a FLARE-UP LIGHT or flare-up lights at short intervals, which shall never exceed fifteen minutes.

On the near approach of or to other vessels they shall have their side-lights lighted, ready for use, and shall FLASH OR SHOW

them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side.

A pilot vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the coloured lights above mentioned, have at hand ready for use a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

A steam pilot vessel exclusively employed for the service of pilots licensed or certified by any pilotage authority, or the committee of any pilotage district, when engaged on her station on pilotage duty and not at anchor, shall, in addition to the lights required for all pilot boats, carry at a distance of 8 feet below her white masthead light a red light visible all round the horizon and of such a character as to be visible on a dark night with a clear atmosphere at a distance of at least 2 miles, and also the coloured side-lights required to be carried by vessels when under way.

When engaged on her station on pilotage duty and at anchor, she shall carry, in addition to the lights required for all pilot boats, the red light above mentioned, but not the coloured side-lights.

Pilot vessels, when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

Lights for Fishing Vessels and Trawlers.

ART. 9.*†—Fishing-vessels and fishing-boats, when under way and when not required by this Article to carry or show the lights hereinafter specified, shall carry or show the lights prescribed for vessels of their tonnage under way.

(*a*) Open boats, by which it is to be understood boats not protected from the entry of sea water by means of a continuous deck, when engaged in any fishing at night, with outlying tackle extending not more than 150 feet horizontally from the boat into the seaway, shall carry one all-round white light.

Open boats, when fishing at night, with outlying tackle

* This Article does not apply to Chinese or Siamese vessels.

† The expression "Mediterranean Sea" contained in sub-sections (*b*) and (*c*) of this Article includes the Black Sea and the other adjacent inland seas in communication with it.

extending more than 150 feet horizontally from the boat into the seaway, shall carry one all-round white light, and in addition, on approaching or being approached by other vessels, shall show a second white light at least 3 feet below the first light and at a horizontal distance of at least 5 feet away from it in the direction in which the outlying tackle is attached.

(*b*)* Vessels and boats, except open boats as defined in sub-division (*a*), when fishing with drift nets, shall, so long as the nets are wholly or partly in the water, carry two white lights where they can best be seen. Such lights shall be placed so that the vertical distance between them shall be not less than 6 feet and not more than 15 feet, and so that the horizontal distance between them, measured in a line with the keel, shall be not less than 5 feet and not more than 10 feet. The lower of these two lights should be in the direction of the nets, and both of them shall be of such a character as to show all round the horizon, and to be visible at a distance of not less than 3 miles.

Within the Mediterranean Sea and in the seas bordering the coasts of Japan and Korea† sailing fishing vessels of less than 20 tons gross tonnage shall not be obliged to carry the lower of these two lights; should they, however, not carry it, they shall show in the same position (in the direction of the net or gear) a white light, visible at a distance of not less than one sea mile, on the approach of or to other vessels.

(*c*) Vessels and boats, except open boats as defined in sub-division (*a*), when line-fishing with their lines out and attached to or hauling their lines and, when not at anchor or stationary within the meaning of sub-division (*h*), shall carry the same lights as vessels fishing with drift nets. When shooting lines, or fishing with towing lines, they shall carry the lights prescribed for a steam or sailing vessel under way respectively.

Within the Mediterranean Sea, and in the seas border-

* Dutch vessels and boats when engaged in the "kol," or hand-line fishing will carry the lights prescribed for vessels fishing with drift nets.

† Also, as regards Russian vessels, in the seas (excluding the Baltic) bordering the coasts of Russia.

ing the coasts of Japan and Korea,‡ sailing fishing-vessels of less than 20 tons gross tonnage shall not be obliged to carry the lower of these two lights; should they, however, not carry it, they shall show in the same position (in the direction of the lines) a white light, visible at a distance of not less than 1 sea mile on the approach of or to other vessels.

(*d*) Vessels, when engaged in trawling, by which is meant the dragging of an apparatus along the bottom of the sea—

1. If steam vessels, shall carry in the same position as the white light mentioned in Article 2 (*a*), a tricoloured lantern so constructed and fixed as to show a white light from right ahead to two points on each bow, and a green light and a red light over an arc of the horizon from two points on each bow to two points abaft the beam on the starboard and port sides respectively; and not less than 6 nor more than 12 feet below the tricoloured lantern a white light in a lantern, so constructed as to show a clear, uniform and unbroken light all round the horizon.

2. If sailing vessels, shall carry a white light in a lantern, so constructed as to show a clear, uniform and unbroken light all round the horizon, and shall also, on the approach of or to other vessels, show, where it can best be seen, a white flare-up light or torch in sufficient time to prevent collision.

All lights mentioned in sub-division (*d*), 1 and 2, shall be visible at a distance of at least 2 miles.

(*e*) Oyster dredgers and other vessels fishing with dredge-nets shall carry and show the same lights as trawlers.

(*f*) Fishing-vessels and fishing-boats may at any time use a flare-up light in addition to the lights which they are by this Article required to carry and show, and they may also use working lights.

(*g*) Every fishing-vessel and every fishing-boat under 150 feet in length, when at anchor, shall exhibit a white

‡ Also, as regards Russian vessels, in the seas (excluding the Baltic) bordering the coasts of Russia.

light visible all round the horizon at a distance of at least 1 mile.

Every fishing-vessel of 150 feet in length or upwards, when at anchor, shall exhibit a white light visible all round the horizon at a distance of at least 1 mile, and shall exhibit a second light as provided for vessels of such length by Article 11.

Should any such vessel, whether under 150 feet in length, or of 150 feet in length or upwards, be attached to a net or other fishing gear, she shall on the approach of other vessels show an additional white light at least 3 feet below the anchor light, and at a horizontal distance of at least 5 feet away from it in the direction of the net or gear.

(*h*) If a vessel or boat when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall in daytime haul down the day-signal required by sub-division (*k*); at night show the light or lights prescribed for a vessel at anchor; and during fog, mist, falling snow, or heavy rain-storms make the signal prescribed for a vessel at anchor. (See sub-division (*d*), and the last paragraph of Article 15.)

(*i*) In fog, mist, falling snow or heavy rain-storms, drift-net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of drag-net, and vessels line-fishing with their lines out, shall, if of 20 tons gross tonnage or upwards, respectively, at intervals of not more than one minute, make a blast; if steam-vessels, with the whistle or syren, and if sailing-vessels with the fog-horn; each blast to be followed by ringing the bell. Fishing-vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals; but if they do not, they shall make some other efficient sound signal at intervals of not more than one minute.

(*k*) All vessels or boats fishing with nets or lines or trawls, when under way, shall in daytime indicate their occupation to an approaching vessel by displaying a basket or other efficient signal where it can best be seen. If vessels or boats at anchor have their gear out, they

shall, on the approach of other vessels, show the same signal on the side on which those vessels can pass.

The vessels required by this Article to carry or show the lights hereinbefore specified shall not be obliged to carry the lights prescribed by Article 4 (*a*), and the last paragraph of Article 11.

Lights for a Vessel being Overtaken.

ART. 10.—A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel A WHITE LIGHT OR A FLARE-UP LIGHT.

The white light required to be shown by this Article may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon of 12 points of the compass, viz., for 6 points from right aft on each side of the vessel, so as to be visible at a distance of at least 1 mile. Such light shall be carried as nearly as practicable on the same level as the side-lights.

Lights for Vessels at Anchor.

ART. 11.—A vessel UNDER 150 FEET in length, when at anchor, shall carry forward, where it can best be seen, but at a height, not exceeding 20 feet above the hull, A WHITE LIGHT in a lantern so constructed as to show a clear, uniform and unbroken light visible all round the horizon at a distance of at least 1 mile.

A vessel of 150 FEET OR UPWARDS in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than 20, and not exceeding 40 feet above the hull, one such light, and AT OR NEAR THE STERN of the vessel, and at such a height that it shall be not less than 15 feet lower than the forward light, ANOTHER SUCH LIGHT.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel AGROUND in or near a fairway shall carry the above LIGHT OR LIGHTS and the TWO RED LIGHTS prescribed by Article 4 (*a*).

Signals to attract Attention

ART. 12.—Every vessel may, if necessary in order to attract attention, in addition to the lights which she is by these Rules

required to carry, show A FLARE-UP LIGHT or use any detonating signal that cannot be mistaken for a distress signal.

Special Lights or Rules.

ART. 13.—Nothing in these Rules shall interfere with the operation of any special Rules made by the Government of any nation with respect to additional STATION AND SIGNAL LIGHTS for two or more ships of war or for vessels sailing under convoy, or with the exhibition of RECOGNITION SIGNALS adopted by shipowners, which have been authorised by their respective Governments, and duly registered and published.

Day Mark for Steam Ship under Sail Only.

ART. 14.—A steam vessel proceeding under sail only, but having her funnel up, shall carry in daytime, forward, where it can best be seen, ONE BLACK BALL OR SHAPE 2 feet in diameter.

Sound Signals for Fog, Etc.

ART. 15.—All signals prescribed by this Article for vessels under way shall be given—

1. By "steam vessels" on the whistle or siren.
2. By "sailing vessels and vessels towed" on the fog-horn.

The words "prolonged blast" used in this Article shall mean a blast of from 4 to 6 seconds' duration.

A steam vessel shall be provided with an efficient whistle or siren, sounded by steam or some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient fog-horn, to be sounded by mechanical means, and also with an efficient bell.* A sailing vessel of 20 tons gross tonnage or upwards shall be provided with a similar fog-horn and bell.

In fog, mist, falling snow, or heavy rain storms, whether by day or night, the signals described in this Article shall be used as follows, viz.:—

(*a*) A steam vessel having way upon her shall sound, at intervals of not more than 2 minutes, A PROLONGED BLAST.

* In all cases where the Rules require a bell to be used, a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.

(*b*) A steam vessel under way, but stopped and having no way upon her, shall sound, at intervals of not more than 2 minutes, TWO PROLONGED BLASTS, with an interval of about 1 second between them.

(*c*) A sailing vessel under way shall sound, at intervals of not more than 1 minute, when on the STARBOARD TACK ONE BLAST, when on the PORT TACK TWO BLASTS in succession, and when with the WIND ABAFT THE BEAM THREE BLASTS in succession.

(*d*) A vessel when at anchor shall, at intervals of not more than 1 minute, ring the bell rapidly for about 5 seconds.

(*e*) A vessel when towing, a vessel employed in laying or in picking up a telegraph cable, and a vessel under way, which is unable to get out of the way of an approaching vessel through being not under command, or unable to manoeuvre as required by these Rules shall, instead of the signals prescribed in sub-divisions (*a*) and (*c*) of this Article, at intervals of not more than two minutes, SOUND THREE BLASTS in succession, viz., one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

Sailing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals, but if they do not, they shall make some other efficient sound signal at intervals of not more than 1 minute.†

Speed of Ships to be Moderate in Fog, Etc.

ART. 16.—Every vessel shall, in fog, mist, falling snow, or heavy rain storms, GO AT A MODERATE SPEED, having careful regard to the existing circumstances and conditions.

A steam vessel hearing, apparently forward of her beam, the fog-signal of a vessel, the position of which is not ascertained, shall, so far as the circumstances of the case admit, STOP HER ENGINES, and then NAVIGATE WITH CAUTION until danger of collision is over.

† Dutch steam pilot-vessels, when engaged on their station on pilotage duty in fog, mist, falling snow or heavy rain storms are required to make at intervals of 2 minutes at most 1 long blast with the siren, followed after 1 second by a long blast with the steam whistle and again after 1 second by a long blast on the siren. When not engaged on their station on pilotage duty, they make the same signals as other steamships.

STEERING AND SAILING RULES

Preliminary—Risk of Collision.

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change such risk should be deemed to exist.

Two Sailing Vessels Meeting.

ART. 17.—When two sailing vessels are approaching one another, so as to involve risk of collision, ONE OF THEM SHALL KEEP OUT OF THE WAY of the other, as follows, viz.:—

(*a*) A vessel which is RUNNING FREE shall keep out of the way of a vessel which is close-hauled.

(*b*) A vessel which is CLOSE-HAULED ON THE PORT TACK shall keep out of the way of a vessel which is close-hauled on the STARBOARD TACK.

(*c*) When both are running free, with the wind on different sides, the vessel which has the WIND ON THE PORT SIDE shall keep out of the way of the other.

(*d*) When both are running free, with the wind on the same side, the VESSEL WHICH IS TO WINDWARD shall keep out of the way of the vessel which is to leeward.

(*e*) A vessel which has THE WIND AFT shall keep out of the way of the other vessel.

Two Steam Vessels Meeting.

ART. 18.—When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, EACH SHALL ALTER HER COURSE TO STARBOARD, so that each may pass on the port side of the other.

This Article only applies to cases where vessels are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are, when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each

vessel sees the masts of the other in a line, or nearly in a line, with her own; and by night, to cases in which each vessel is in such a position as to see both the side-lights of the other.

It does not apply, by day, to cases in which a vessel sees another ahead crossing her own course; or by night, to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

Two Steam Vessels Crossing.

ART. 19.—When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other ON HER OWN STARBOARD SIDE shall keep out of the way of the other.

Steam Vessel and Sailing Vessels.

ART. 20.—When a steam vessel and a sailing vessel are proceeding in such directions as to involve risk of collision, the STEAM VESSEL shall keep out of the way of the sailing vessel.

When a Vessel is required to keep her Course.

ART. 21.—Where by any of these Rules one of two vessels is to keep out of the way, the other SHALL KEEP HER COURSE AND SPEED.

Note.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision cannot be avoided by the action of the giving-way vessel alone, she also shall TAKE SUCH ACTION AS WILL BEST AID TO ADVERT COLLISION. (See Articles 27 and 29.)

Crossing Ahead to be Avoided.

ART. 22.—Every vessel which is directed by these Rules to keep out of the way of another vessel shall, if the circumstances of the case admit, AVOID CROSSING AHEAD OF THE OTHER.

Steam Vessel to Slacken Speed.

ART. 23.—Every steam vessel which is directed by these Rules to keep out of the way of another vessel shall, on approaching her, if necessary, SLACKEN HER SPEED OR STOP OR REVERSE.

As to Overtaking Vessels.

ART. 24.—Notwithstanding anything contained in these Rules, every vessel, overtaking any other, SHALL KEEP OUT OF THE WAY OF THE OVERTAKEN VESSEL.

Every vessel coming up with another vessel from any direction more than 2 points abaft her beam, *i.e.*, in such a position, with reference to the vessel which she is overtaking, that at night she would be unable to see either of that vessel's side-lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these Rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is FINALLY PAST AND CLEAR.

As by day the overtaking vessel cannot always know with certainty whether she is forward or abaft this direction from the other vessel, she should, IF IN DOUBT, assume that she is an overtaking vessel and KEEP OUT OF THE WAY.

Steam Vessel in Narrow Channels.

ART. 25.—In narrow channels every steam vessel shall, when it is safe and practicable, KEEP TO THAT SIDE of the fairway or mid-channel which lies on the STARBOARD SIDE OF SUCH VESSEL.

Fishing Boats to be Avoided.

ART. 26.—Sailing vessels under way shall keep out of the way of SAILING VESSELS OR BOATS FISHING WITH NETS, OR LINES, OR TRAWLS. This Rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fairway used by vessels other than fishing vessels or boats.

Proviso for Special Cases.

ART. 27.—In obeying and construing these Rules, due regard shall be had to all dangers of navigation and collision and to

any SPECIAL CIRCUMSTANCES which may render a departure from the above Rules necessary in order to avoid immediate danger.

Sound Signals for Vessels in Sight of one Another.

ART. 28.—The words "SHORT BLAST" used in this Article shall mean a blast of about ONE SECOND'S DURATION.

When vessels are in sight of one another, a steam vessel under way, in taking any course authorised or required by these Rules, shall indicate that course by the following signals on her whistle or siren, viz.:—

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going full speed astern."

No Vessel under any Circumstances to neglect proper Precautions.

ART. 29.—Nothing in these Rules shall exonerate any vessel, or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Reservation of Rules for Harbours and Inland Navigation.

ART. 30.—Nothing in these Rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbour, river, or inland waters.

Distress Signals.

ART. 31.—When a vessel is in distress and requires assistance from other vessels or from the shore, the following shall be the signals to be used or displayed by her, either together or separately, viz.:—

(*a*) **Day-time Signals**:—

The International Code signal of distress indicated by NC.

The distant signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball.

(*b*) **Night-time Signals**:—

Flames on the vessel (as from a burning tar-barrel, oil-barrel, etc.).

Rockets or shells, throwing stars of any colour or description, fired one at a time, at short intervals.

(*c*) **Day-time and Night-time Signals**:—

A gun or other explosive signal fired at intervals of about a minute.

A continuous sounding with any fog-signalling apparatus.

* A signal made by radiotelegraphy or by any other distance signalling method consisting of the group ▬ ▬ ▬ ▬ ▬ in the Morse Code.

* A signal sent by radiotelephony consisting of the spoken word "Mayday".

* The alarm signal, that is to say, a signal sent by radiotelegraphy in the Morse Code consisting of a series of twelve dashes, each of four seconds duration, transmitted in one minute with an interval of one second between each dash.

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* *Note.*—Prescribed by Order in Council dated the 10th day of November, 1932. (S.R. & O. No. 945.)

REGULATIONS FOR PREVENTING COLLISIONS AT SEA.

The first few words of each Article to assist Candidates to remember them by their numbers.

Preliminary.

These Rules shall be followed by all vessels.

ART. 1.—The Rules concerning lights shall be complied
" 2.—A steam-vessel when under way shall carry
" 3.—A steam-vessel when towing another vessel shall
" 4.—A vessel which is not under command
" 5.—A sailing-vessel under way, and any vessel being towed
" 6.—Whenever, as in the case of small vessels
" 7.—Steam-vessels of less than 40
" 8.—Sailing pilot-vessels when engaged on their station
" 9.—Fishing vessels and fishing boats, when under way
" 10.—A vessel when under way shall carry
" 11.—A vessel under 150 ft. in length when at anchor
" 12.—Every vessel may, if necessary, in order to attract attention
" 13.—Nothing in these Rules shall interfere
" 14.—A vessel proceeding under sail when
" 15.—All signals prescribed by this article
" 16.—Every vessel shall, in a fog, mist, falling snow

Steering and Sailing Rules.

Preliminary—Risk of collission can
ART. 17.—When two sailing-vessels are approaching
" 18.—When two steam-vessels are meeting end on

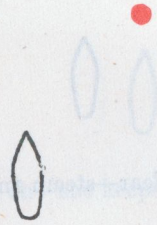
ART. 19.—When two steam-vessels are crossing
" 20.—When a steam-vessel and a sailing vessel are
" 21.—Where by any of these Rules one of two vessels
" 22.—Every vessel which is directed by these Rules
" 23.—Every steam-vessel which is directed by these Rules
" 24.—Notwithstanding anything contained in these Rules, every vessel, overtaking any other
" 25.—In narrow channels every steam-vessel shall
" 26.—Sailing-vessels under way shall keep out of the way of
" 27.—In obeying and construing these Rules due
" 28.—The words "short blast" used in this Article
" 29.—Nothing in these Rules shall exonerate
" 30.—Nothing in these Rules shall interfere with the operation of a special Rule
" 31.—When a vessel is in distress and requires assistance

RULE OF THE ROAD.

In the following diagrams you are supposed to be in a steam vessel.

Red Light on Starboard Bow.

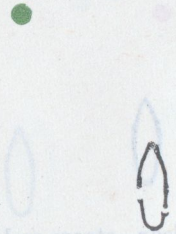
DIAGRAM A.



Keep clear—steam and sail.

Green Light on Port Bow

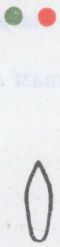
DIAGRAM B.



Keep clear—steam and sail.

Two Lights Ahead.

DIAGRAM C.



Keep clear—steam and sail.

Two Lights on Starboard Bow.

DIAGRAM D.

Keep clear—steam and sail.

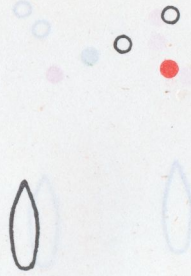
Two Masthead and Green Lights on Port Bow.

DIAGRAM E.

Stand on—she keeps clear.

Two Masthead and Red Light on Starboard Bow.

DIAGRAM F.



Keep clear—she is on my starboard side.

Two Masthead and Two Side-lights Ahead.

DIAGRAM G.

Alter course to starboard, meeting end on.

Two Masthead and Two Side-lights on Starboard Bow

DIAGRAM H.

Keep clear—she is on my starboard side.

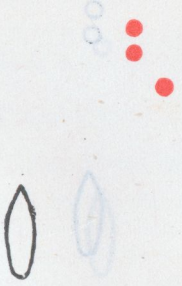
Red, White, Red and Green on the Port Bow.

DIAGRAM J.

Keep clear—vessel laying or picking up a submarine cable, making way through the water.

Two Red Lights and Another Red Below them.

DIAGRAM K.



Keep clear—vessel not under command making way through the water.

Green over White on Port Bow.

DIAGRAM L.

Keep clear—she is a steam vessel engaged in trawling.

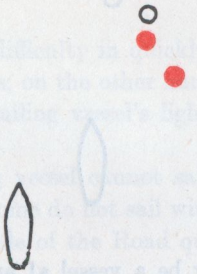
Two White Lights Ahead.

DIAGRAM M.

Keep clear—it may be two masthead lights, no side-lights visible; two lights of a tug, no side-lights visible; a vessel at anchor; a drift net fishing vessel or the two lights of a steam trawler end on.

White over Red Light and Red Light below on Starboard Bow.

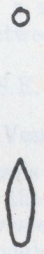
DIAGRAM N.



Keep clear—she is a steam pilot vessel.

White Light Ahead.

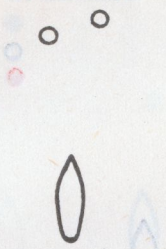
DIAGRAM O.



Keep clear—it may be a stern light, fishing vessel, open boat, vessel at anchor, masthead light, etc.

Two White Lights Ahead

DIAGRAM P.



Keep clear—it may be a vessel at anchor; a drift net fishing vessel or two masthead lights with no side-lights visible.

RULE OF THE ROAD.

To understand "Rule of the Road" in relation to both sailing vessels and steam vessels it is essential to have a thorough knowledge of the Articles, especially the Steering and Sailing Rules. It is also quite necessary to be able to "box the compass" quickly and intelligently.

There should be little difficulty in quickly mastering the rules as applied to steam vessels; on the other hand, the questions that may be put concerning sailing vessel's lights call for somewhat more thought.

A square-rigged sailing vessel cannot sail closer to the wind than 6 points (probably some do not sail within 6½ to 7 points).

For the purposes of Rule of the Road questions it is usual to allow 6 points.

To Find How a Steam Vessel may be Heading.

Rule.—Observe the compass bearing of the light, reverse this bearing and allow 10 points to the right of the reversed bearing for a *red* light, but 10 points to the *left* for a green light.

Example 1.—Heading North, a steam vessel's masthead and red lights are seen ahead; between what points may she be heading?

Ans.—Between South and W.N.W.

Example 2.—Heading E.N.E. a steam vessel's masthead and green lights are seen ahead; between what points may she be heading?

Ans.—Between W.S.W. and S.E.

To Find how a Sailing Vessel may be Heading.

The rules given for steam vessels also apply to sailing vessels, but allowance must be made for the direction of the wind.

As already explained, sailing vessels cannot sail within 6 points of the wind and therefore, although they may be heading closer than 6 points, it will only be when they are in the act of tacking.

If then questions are put:—Between what points is a sailing vessel *sailing*?

Two White Lights Ahead

DIAGRAM P.

Keep clear—it may be a vessel at anchor; a drift net fishing vessel or two masthead lights with no side-lights visible.

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Ans.—Between South and W.N.W.

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Ans.—Between W.S.W. and S.E.

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As already explained, sailing vessels cannot sail within 6 points of the wind and therefore, although they may be heading closer than 6 points, it will only be when they are in the act of tacking.

If then questions are put:—Between what points is a sailing vessel *sailing*?

You must take the bearing of the light, reverse this bearing and allow 10 points to the *left* of it for a green light, 10 points to the right for a *red* light, and then consider the direction of the wind and remember that she cannot sail closer than 6 points to this direction.

A few examples should make this clear.

Example 1.—Heading North, wind aft, a sailing vessel's red light is sighted two points on the starboard bow; between what points can she be sailing?

Ans.—The red light bears N.N.E., the reversed bearing is S.S.W. and 10 points to the right of this is N.W., therefore she can head between these points. As the wind is South and she cannot sail nearer the wind than 6 points, we must allow 6 points from South and the answer becomes between W.S.W. and N.W.

Example 2.—Heading North, Wind S.E. a sailing vessel's green light is observed 2 points on the port bow; between what points is she sailing?

Ans.—The green light bears N.N.W., the reversed bearing is S.S.E., 10 points to the left of this is N.E., therefore she can head between these points, but as she cannot sail closer than 6 points to the direction of the wind the answer becomes E.N.E. and N.E.

From the above questions you will notice how it is possible to decide whether a ship can be close-hauled, free or in stays.

Example 3.—Heading North, wind S.W. a sailing vessel's green light is observed 4 points on the port bow; between what points is she sailing and is it possible for her to be close-hauled?

Ans.—The green light bears N.W. and she can head between the opposite point, *i.e.*, S.E. and 10 points to the left of it, *i.e.* N.N.E. As a sailing vessel on the starboard tack, with a S.W. wind, would head S.S.E. if close-hauled, you will see that she cannot be close-hauled but must be free and may have the wind from near the starboard beam to about two points on the port quarter.

Candidates who may be going in for the "Sailing Ship Endorsement" must be prepared to answer questions as to whether, or not, it is their duty to give way for other sailing vessels.

A sound knowledge of Article 17 together with the preceding rules should help towards making such questions simple.

Questions may be given on the approximate course another vessel was steering when her light disappeared.

By this is meant, a vessel is so heading that two points abaft her beam in just passing your view.

Example.—A green light is in view bearing W.N.W. and whilst on that bearing shuts in. How was she heading?

It is evident that a point two points before her port beam must bear W.N.W. from your ship, she must therefore be heading North.

A very simple rule to remember. Take the bearing of the light and from this allow 6 points to the *left* for a *red* light but 6 points to the *right* for a *green*. Thus you obtain the direction in which the other vessel was going when the light disappeared.

Example.—Heading North, a green light ahead disappears. How was she heading at that time. A green light will show in a vessel bearing North from your ship, if she is heading between South and E.N.E., but as the light would not disappear on any of the courses if the vessel were advancing towards us, she must have been steering E.N.E.; in other words, 6 points to the right of N.

When there is danger of collision between a sailing vessel and a steam vessel the steamer must keep out of the way, but if a sailing vessel is overtaking a steam vessel, the overtaking vessel must keep out of the way. A sailing vessel should also keep out of the way of a vessel not under command: also keep out of the way of any steam vessel employed in laying, picking up, or repairing a telegraph cable.

Sailing vessels under way should keep out of the way of fishing vessels under sail (or boats) engaged in fishing with nets, lines and trawls. Sailing vessels and steam vessels should keep out of the way of steam fishing vessels engaged in trawling. The "tripex light" is to show vessels approaching that the trawlers with their trawls down are incapable of obeying the ordinary sea rules, and therefore other vessels approaching them must keep out of the trawler's way.

In the following questions give the approximate course the vessels were heading when the lights disappeared.

Q. Heading N., a green light 2 points on the port bow disappears.

A. N.E.

Q. Heading N.W., a red light 2 points on the starboard bow disappears.
A. West.

Q. Heading E.N.E., a green light 4 points on the port bow disappears.
A. East.

Q. Heading S., a red light 4 points on the starboard bow disappears.
A. S.S.E.

Q. Heading S.W., a green light 2 points on the port bow disappears.
A. West.

Q. Heading N., a red light 2 points abaft the port beam disappears.
A. South.

Q. Heading N., a green light 3 points abaft the starboard beam disappears.
A. S. by W.

RULE OF THE ROAD.

(Sailing Vessels).

Wind aft, you observe a red light 1 point on your starboard bow.
Keep out of the way.

Wind aft, you observe a green light on your starboard bow.
Stand on, passing vessels.

Wind aft, you observe a green light ahead.
Keep out of the way.

Wind aft, you observe a red and green light ahead.
Stand by to keep out of the way, the other vessel is in stays.

Wind aft, you observe a steam vessel's lights ahead.
Stand on.

Wind aft, you observe a stern light nearly ahead.
Keep out of the way.

Braced up on the port tack, you observe another ship bearing down on the starboard tack.
Keep out of the way.

Braced up on the starboard tack, you observe another vessel heading towards you on the port tack.
Stand on.

Wind on the starboard quarter, you observe another vessel coming towards you on the port tack.
Keep out of the way.

Wind on the port quarter, you observe another vessel heading towards you on the starboard tack.
Keep out of the way.

You are running free with the wind on the port side, and another vessel is heading towards you with the wind free on the starboard side.
Keep out of the way.
Note.—If both ships are running free, with the wind on the same side, the weather ship keeps out of the way.

QUESTIONS ON THE RULE OF THE ROAD.

How do you ascertain how a vessel is heading by the bearing of her lights?
Rule.—For a green side-light, reverse the bearing and allow 10 points to the left of the reversed bearing.
Rule.—For a red side-light, reverse the bearing and allow 10 points to the right of the reversed bearing.

If you observe a green light bearing N.N.E., how may that vessel be heading?
The screens being properly fitted, the light will be seen between S.S.W. to East.
Note.—The opposite bearing is S.S.W., and 10 points to the left is East.

If you observe a red light bearing N.W., how may that vessel be going?

The screens being properly fitted, the light will be seen between S.E. to W.S.W.

Note.—The opposite bearing is S.E., and 10 points to the right is W.S.W.

A green light bearing North, how may that vessel be going?

Between South and E.N.E.

A red light bearing North, how may that vessel be heading?

Between South and W.N.W.

A sailing vessel's red side-light is observed bearing N.E., how is that vessel heading?

Between S.W. and N.N.W.

A sailing vessel's green side-light is observed bearing N.E., how is the vessel going?

Between S.W. and E.S.E.

A steam vessel's green side-light is bearing N.W., how is the vessel heading?

Between S.E. and N.N.E.

A steam-vessel's red side-light is observed bearing S.E., how may that steamer be going?

Between N.W. and E.N.E.

A sailing vessel's red light is observed bearing S.W., how is that vessel heading?

Between N.E. and S.S.E.

How do you know?

Because the screens being properly fitted, the light can only be seen over an arc of 10 points of the compass.

A steam vessel's green light bearing South, how may that vessel be heading?

Between North and W.S.W.

A steam vessel's red light bearing South, how may that vessel be heading?

Between North and E.S.E.

A sailing vessel's green side-light disappears bearing North, how was the vessel heading at that moment?

E.N.E.

A steam vessel's red side-light disappears bearing South, how was the vessel heading at that time?

E.S.E.

At what distance should a steam vessel's masthead light (or lights) be visible?

At least 5 miles.

At what distance are the side-lights visible?

At least 2 miles.

At what distance is a stern-light visible?

At least 1 mile.

At what distance is the anchor-light visible?

At least 1 mile.

At what distance is a drift net fishing vessel's lights visible?

At least 3 miles.

At what distance is the red light visible which a steam pilot vessel exhibits?

At least 2 miles.

Questions on Article 9.

ART. 9.—What lights are required by open boats when engaged in any fishing at night?

(*a*) Open boats when fishing at night, with outlying tackle extending more than 150 feet horizontally from the boat into the seaway, shall carry one all-round white light, and in addition, on approaching or being approached by other vessels, shall

show a second white light at least 3 feet below the first light and at a horizontal distance of at least 5 feet away from it in the direction in which the outlying tackle is attached.

What lights are required by vessels when fishing with drift nets?

(*b*) Vessels and boats, except open boats as defined in subdivision (*a*), when fishing with drift nets, shall, so long as the nets are wholly or partly in the water, carry two white lights where they can best be seen. Such lights shall be placed so that the vertical distance between them shall be not less than 6 feet and not more than 15 feet, and so that the horizontal distance between them, measured in a line with the keel, shall be not less than 5 feet and not more than 10 feet. The lower of these two lights shall be in the direction of the nets, and both of them shall be of such a character as to show all round the horizon, and to be visible at a distance of not less than 3 miles.

What are the lights required by vessels engaged in trawling?

1. If steam vessels, shall carry in the same position as the white light mentioned in Article 2 (*a*), a tricoloured lantern, so constructed and fixed as to show a white light from right ahead to two points on each bow, and a green light and a red light over an arc of the horizon from two points on each bow to two points abaft the beam on the starboard and port sides respectively; and not less than 6 nor more than 12 feet below the tricoloured lantern a white light in a lantern, so constructed as to show a clear, uniform and unbroken light all round the horizon.

2. If sailing vessels, shall carry a white light in a lantern, so constructed as to show a clear, uniform and unbroken light all round the horizon, and shall also, on the approach of or to other vessels, show, where it can best be seen, a white flare-up light or torch in sufficient time to prevent collision.

All lights mentioned in subdivision (*d*) 1 and 2 shall be visible at a distance of at least 2 miles.

(*e*) Oyster dredgers and other vessels fishing with dredge-nets shall carry and show the same lights as trawlers.

What are the day signals?

All vessels or boats fishing with nets or lines or trawls, when under way, shall in daytime indicate their occupation to an approaching vessel by displaying a basket or other efficient signal where it can best be seen. If vessels or boats at anchor have their gear out, they shall, on the approach of other vessels, show the same signal on the side on which those vessels can pass.

If a vessel or boat when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall in daytime haul down the day signal required by subdivision (*k*); at night show the light or lights prescribed for a vessel at anchor; and during fog, mist, falling snow, or heavy rain-storms, make the signal prescribed for a vessel at anchor. (*See* subdivision (*d*) and the last paragraph of Article 15.)

In fog, mist, falling snow, or heavy rain-storms, drift-net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of drag-net, and vessels line fishing with their lines out, shall, if of 20 tons gross tonnage or upwards, respectively, at intervals of not more than one minute make a blast; if steam vessels, with the whistle or syren, and if sailing vessels with the fog-horn; each blast to be followed by ringing the bell. Fishing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals; but if they do not, they shall make some other efficient sound signal at intervals of not more than one minute.

Note.—Fishing vessels and fishing-boats may at any time use a

flare-up light in addition to the lights which they are by this Article required to carry and show, and they may also use working lights.

What lights are required when a fishing vessel is at anchor?

Every fishing vessel and every fishing boat under 150 feet in length, when at anchor, shall exhibit a white light visible all round the horizon at a distance of at least 1 mile.

Every fishing vessel of 150 feet in length or upwards, when at anchor, shall exhibit a white light visible all round the horizon at a distance of at least 1 mile, and shall exhibit a second light as provided for vessels of such length by Article 11.

Should any such vessel, whether under 150 feet in length, or of 150 feet in length or upwards, be attached to a net or other fishing gear, she shall, on the approach of other vessels, show an additional white light at least 3 feet below the anchor light, and at a horizontal distance of at least 5 feet away from it in the direction of the net or gear.

Have sailing vessels under way to keep out of the way of sailing vessels and boats fishing?

Yes, they have to keep out of the way of sailing vessels or boats fishing with nets, or lines, or trawls; but this rule does not give to any vessel or boat engaged in fishing the right of obstructing a fairway used by vessels other than fishing vessels or boats.

When by the Rules one of two ships is required to keep out of the way of the other, what is the other to do?

To keep her course and speed.

Is there any qualification or exception to this?

Yes, due regard must be had to all dangers of navigation and collision, and to any special circumstances which may exist

in any particular case and require a departure from the regulations to avoid immediate danger.

Is there any general direction in the steering and sailing rules; and if so, what is it?

Yes, it is this: that nothing in the rules shall exonerate any vessel, or the owner, master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper look-out, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Is there any special rule for steam vessels navigating narrow channels?

In narrow channels every steam vessel must, when it is safe and practicable, keep to that side of the fairway or mid-channel which is on the starboard side of such vessel.

Do the Regulations for preventing collisions at sea apply to sea-going vessels in harbours and in rivers?

Yes; unless there is any rule to the contrary made by a competent authority.

Is one vessel bound to assist another in case of collision?

Yes.

What is the penalty for default?

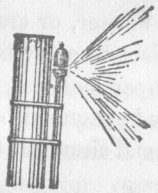
If the master or person in charge of the vessel fails to render assistance without reasonable excuse, the collision is, in absence of proof to the contrary, to be deemed to be caused by his wrongful act, neglect, or default.

Is there any other penalty attached to not rendering assistance?

Yes. If it is afterwards proved that he did not render assistance, his certificate may be cancelled or suspended by the Court investigating the case.

FOG SIGNALS (see Article 15).

Steam Vessels—Sound Signals for Fog on the Steam Whistle or Syren.



Steam vessel having way upon her gives 1 prolonged blast at intervals of not more than 2 minutes.

Steam vessel under way, but stopped and having no way upon her, shall sound at intervals of not more than 2 minutes, 2 prolonged blasts, with an interval of about 1 second between them.

Telegraph vessels employed in laying or in picking up a telegraph cable, and a vessel under way, not under command, shall sound, at intervals of not more than 2 minutes, 3 blasts in succession, viz., 1 prolonged blast followed by 2 short blasts.

A vessel towed may give this signal and she shall not give any other.

Note.—The words "prolonged blast" shall mean a blast of from 4 to 6 seconds duration.

Sailing Vessels—Sound Signals for Fog on Fog Horn.

Sailing vessel under way on the starboard tack gives 1 blast at intervals of not more than 1 minute.

Sailing vessel under way on the port tack gives 2 blasts in succession at intervals of not more than 1 minute.

Sailing vessel with wind abaft the beam gives 3 blasts in succession at intervals of not more than 1 minute.

Vessels at anchor—a bell rung rapidly for about 5 seconds at intervals of not more than 1 minute.

Note.—In all cases where the Rules require a bell to be used, a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.

Pilot Signals.

The following signals, when used or displayed together or separately, are the pilot signals:—

In the daytime—

(1) The International Code Signal G, signifying "I require a Pilot";

(2) The International Code Signal PT, signifying "I require a Pilot";

(3) The Pilot Jack hoisted at the fore.

At night—

(1) The pyrotechnic light, commonly known as a *blue* light, every fifteen minutes;

(2) A bright *white* light, flashed or shown at short or frequent intervals just above the bulwarks for about a minute at a time;

(3) The International Code Signal PT by flashing.

Signals for Pilots in Fog.

On the 1st December, 1937, the Trinity House gave effect to a new regulation which provides from that date that the sound signal to be given by vessels requiring the services of pilots in thick or foggy weather will be the International Code Signal "G".

In those districts where pilot vessels cruise on station they will sound on their whistles or fog-horns the International Code Numeral 5 in thick or foggy weather.

An exception to the above is in the Neath Pilotage District where the International Code Numeral 1 is used.

Quarantine Signals.

The following signals are to be shown on arrival by vessels requiring or required to show their state of health:—

In the daytime—

(1) The Flag Signal Q: signifying—"My ship is *healthy* and I request free pratique";

(2) The Two Flag Signal QQ: signifying—"My ship is *suspect*, that is to say, I have had a case or cases of infectious disease more than five days ago, or there is an unusual mortality among rats on board"; or

(3) The Two Flag Signal QL: signifying—"My ship is *infected*, that is to say, I have had a case or cases of infectious disease less than five days ago."

The day signal shall be shown at the masthead or where it can best be seen.

At night—

A signal comprising a red light over a white light, the lights being not more than six feet apart, and signifying—"I have not free pratique."

The night signal shall be shown at the peak or other conspicuous place where it can best be seen. This signal is only to be exhibited within the precincts of a port.

EXAMINATION IN THE REGULATIONS FOR PREVENTING COLLISIONS AT SEA.

All applicants for examination, whether for certificates as Masters or Mates, are to be examined as to their knowledge of the regulations each time they present themselves for examination.

QUESTIONS AND ANSWERS.

Where and by what vessels are the Rules to be followed?

The Rules are to be followed by all vessels upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

When is a steam vessel considered a sailing vessel, and when a steam vessel?

Under the Rules every steam vessel which is under sail and not under steam is to be considered a sailing vessel, and every vessel under steam, whether under sail or not, is to be considered a steam vessel.

What does the word "steamvessel" in the Rules include?

The word "steamvessel" as used in the Rules includes any vessel propelled by machinery.

When is a vessel considered to be under way by these Rules?

When she is not at anchor, or made fast to the shore, or aground.

What does the word "visible" in the Rules, when applied to lights, mean?

Visible on a dark night with a clear atmosphere.

During what time must the Rules concerning lights be complied with?

In all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights or impair their visibility shall be exhibited.

What light or lights are required by the Regulations to be exhibited by sailing vessels at anchor?

If they are under 150 feet in length, 1 white light; if of 150 feet or upwards, 2 white lights, 1 forward and 1 aft.

What light or lights are required by the Regulations to be exhibited by steam vessels at anchor?

The same as by sailing vessels.

Where is the anchor light to be exhibited in a vessel under 150 feet in length?

Forward, where it can best be seen. It must be placed where there is the least chance of obstruction from spars, ropes, etc.; and must not be more than 20 feet above the hull.

Where must the two anchor lights be shown in vessels of 150 feet and upwards?

In vessels of 150 feet or upwards in length one light must be carried in the forward part of the vessel at a height of not less than 20 feet and not more than 40 feet above the hull; and another light at or near the stern not less than 15 feet lower than the forward light.

In what direction or directions must the anchor lights show?
They must show a clear, uniform, and unbroken light visible all round the horizon.

At what distance must they be visible?
At least 1 mile.

What shall be deemed to be the length of a vessel?
The length appearing in the certificate of registry.

What light or lights must a vessel aground in or near a fairway carry?
The light or lights prescribed for a vessel at anchor, and in addition the 2 red lights prescribed for a vessel not under command.

What is the number of lights required by the regulations to be carried by sailing vessels when under way at night?
Two side-lights, and a stern light.

What description of light must be shown from the sides of sailing vessels under way; and over how many points of the compass, and in what directions, and how far, are they required to show?
Each light must be so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass; so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard and port sides respectively; and of such a character as to be visible at a distance of at least 2 miles.

What lights are they to carry when being towed at night?
The same.

Are the side-lights required to be fitted with screens; and if so, of what length, and how?
Yes, on the inboard side; at least 3 feet in length, measuring forward from the light, so as to prevent the lights from being seen across the bow.

What is the number of lights required by the regulations to be carried by steam vessels when under way at night?
Four, the masthead light, two side-lights and stern light.

Of what colour are these lights, and how are they to be placed on board the ship?
A white light on or in front of the foremast, or if a vessel without a foremast, then in the forepart of the vessel, at a height above the hull of not less than 20 feet, and if the breadth of the vessel exceeds 20 feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height than 40 feet. A green light on the starboard side, and a red one on the port side. A steam vessel may carry an additional masthead light.

Over how many points of the compass, in what direction, and how far, is the foremast-head light of a steam vessel required to show?
Over 20 points, viz., from right ahead to 2 points abaft the beam on each side. It must be of such a character as to be visible at a distance of at least 5 miles.

Are the side-lights required to be fitted with screens; and if so, of what length?
The green and red lights are to be fitted with screens on the inboard side, extending at least 3 feet forward from the light so as to prevent these lights from being seen across the bow.

Over how many points of the compass, in what directions, and how far, are the coloured side-lights of steam vessels required to show?
The side-lights must be so constructed as to show an unbroken light over an arc of the horizon 10 points of the compass on each side of the ship, *i.e.*, from right ahead to 2 points abaft the beam on the starboard and port sides respectively, and of such a character as to be visible at a distance of at least 2 miles.

What description of lights are steam vessels required to carry when they are not under steam, but under sail only?

Side-lights only, the same as sailing vessels.

What exceptional lights may small vessels carry?

Whenever, as in the case of small vessels during bad weather, the green and red side-lights cannot be fixed, these lights shall be kept at hand lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side, nor the red light on the starboard side; nor, if practicable, more than 2 points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the colour of the light they respectively contain, and shall be provided with proper screens.

Are steam vessels of less than 40 tons gross tonnage compelled to carry the same lights as other steam vessels; if not, what lights may they carry instead?

No; but if they do not carry the ordinary lights they must carry in the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the gunwale of not less than 9 feet, a bright white light to show over the same arc as the ordinary masthead light, and to be visible at a distance of at least 2 miles. Also a combined lantern showing a green light and a red light from right ahead to 2 points abaft the beam on their respective sides, such lantern to be carried not less than 3 feet below the white light, the lights being visible at a distance of at least 1 mile.

Are small steamboats such as are carried by sea-going vessels obliged to carry the white light 9 feet above the gunwale?

No; but it must be carried above the combined lantern.

What lights may vessels under oars or sails of less than 20 tons gross tonnage carry?

They shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side, to be visible at least 1 mile.

What lights must rowing boats, whether under oars or sails, carry?

They must have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

What description of lights are pilot vessels required to carry when on their stations on pilotage duty?

A pilot vessel, when engaged on her station on pilotage duty, shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all round the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed 15 minutes. Also on the near approach of or to other vessels they shall have their side-lights lighted ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side.

What lights may pilot vessels which are obliged to go alongside of a vessel to put a pilot on board, carry?

They may show the white light instead of carrying it at the masthead, and may, instead of the coloured side-lights, have at hand ready for use a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed for the coloured side-lights.

What description of lights are steam pilot vessels required to carry when on their stations on pilotage duty in British waters, and not at anchor?

A steam pilot vessel when engaged on her station on pilotage duty and in British waters, and not at anchor, shall, in addition to the lights required for all pilot vessels, carry at a distance of 8 feet below her white masthead light a red light visible all round the horizon for at least 2 miles, and also the coloured side-lights required to be carried by vessels under way.

What description of lights are steam pilot vessels required to carry when on their stations on pilotage duty in British waters, and at anchor?

A steam pilot vessel when engaged on pilotage duty in British waters and at anchor shall carry, in addition to the lights required for all pilot vessels, the red light 8 feet below her white light, but not the coloured side-lights.

What description of lights are pilot vessels required to carry when not on their station on pilotage duty?

A pilot vessel, when not engaged on her station on pilotage duty, shall carry lights similar to those of other vessels of her tonnage.

What lights are steam vessels required to carry when towing other vessels?

A steam vessel, when towing another vessel, shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other not less than 6 feet apart, and when towing more than one vessel shall carry an additional bright white light 6 feet above or below such lights, if the length of the tow, measuring from the stern of the towing vessel to the stern of the last vessel towed, exceeds 600 feet. Each of these lights shall be of the same construction and character, and shall be carried in the same poition as the white light

(Article 2 (*a*)) which other steam vessels are required to carry, except the additional light, which may be carried at a height not less than 14 feet above the hull.

May a vessel towing carry any other light?

Yes. A small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

What light is a vessel which is being overtaken by another required to show if unable on account of bad weather to carry the fixed stern light?

A vessel which is being overtaken by another shall show from her stern to the other vessel a white light or a flare-up light.

Describe the lights, and the day signals, that vessels employed in laying or in picking up a telegraph cable are required to carry.

A vessel employed in laying or in picking up a telegraph cable shall at night carry in the same position as the white light which steam vessels are required to carry, 3 lights in a vertical line one over the other, not less than 6 feet apart; the highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all round the horizon at a distance of at least 2 miles. By day she shall carry in a vertical line one over the other, not less than 6 feet apart, where they can best be seen, 3 shapes not less than 2 feet in diameter, of which the top and bottom shall be globular in shape and red in colour, and the middle one diamond in shape and white.

Describe the lights and the day signals that vessels which from any cause are not under command are required to carry.

A vessel which is not under command shall carry, where they can best be seen, and if a steam vessel, in place of that light 2 red lights in a vertical line one over the other, not less than 6 feet apart, and of such a character as to be visible all round the horizon at a distance of at least 2 miles; and shall by day

carry in a vertical line one over the other, not less than 6 feet apart, where they can best be seen, 2 black balls or shapes, each 2 feet in diameter. The lower light shall not be less than 14 feet above the hull.

Are the above-mentioned vessels to carry side-lights?

The above vessels, when not making any way through the water, shall not carry the side-lights, but when making way shall carry them.

What are the shapes and lights carried by telegraph ships and ships not under command intended to indicate to approaching vessels?

These shapes and lights are to be taken by approaching vessels as signals that the ship using them is not under command, and cannot therefore get out of the way.

Do these Rules prevent squadrons and convoys from carrying special lights, or vessels exhibiting recognition signals?

No. Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal lights for two or more ships of war, or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by shipowners, which have been authorised by their respective Governments and duly registered and published.

May vessels exhibit any other lights in order to attract attention?

Yes. In addition to the lights which she is required to carry she may show a flare-up light, or use any detonating signal that cannot be mistaken for a distress signal.

What signal must a steam vessel proceeding under sail when also under steam or some other mechanical power carry in the daytime?

She must carry forward, where it can best be seen, one black ball or shape, 2 feet in diameter.

What sound signals are steam vessels and sailing vessels of 20 tons gross tonnage or upwards required by the Regulations to be provided with?

A steam vessel shall be provided with an efficient whistle or syren sounded by steam or some substitute for steam, so placed that the sound may not be intercepted by any obstructions, and with an efficient fog horn, to be sounded by mechanical means, and also with an efficient bell. A sailing vessel of 20 tons gross tonnage or upwards shall be provided with a similar fog horn and bell.

When are these signals to be used?

In fog, mist, falling snow, or heavy rain storms, whether by day or night.

What does a prolonged blast mean?

A blast of from 4 to 6 seconds duration.

On what are the fog signals to be made by steam vessels under way?

On the whistle or siren.

On what are the fog signals to be made by sailing vessels and vessels towed?

On the fog horn.

What sound signal is to be made by vessels at anchor?

Vessels at anchor shall, at intervals of not more than 1 minute, ring the bell rapidly for about 5 seconds.

What sound signal is required to be made by a steam vessel having way upon her?

A steam vessel having way upon her shall sound at intervals of not more than 2 minutes a prolonged blast.

What sound signal is required to be made by a steam vessel under way, but stopped, and having no way upon her?

A steam vessel under way, but stopped and having no way upon her, shall sound at intervals of not more than 2 minutes, 2 prolonged blasts, with an interval of about 1 second between them.

What sound signals are required to be made by sailing vessels when under way?

A sailing vessel under way shall sound, at intervals of not more than 1 minute when on the starboard tack, 1 blast; when on the port tack 2 blasts in succession, and when with the wind abaft the beam 3 blasts in succession.

What sound signals are required to be made by a vessel when towing, a vessel employed in laying or in picking up a telegraph cable, or a vessel under way which is unable to get out of the way of an approaching vessel through not being under command or unable to manoeuvre as required by the Rules?

A vessel towing, or when laying or picking up a telegraph cable, or when unable to get out of the way, shall at intervals of not more than 2 minutes sound 3 blasts in succession, viz., 1 prolonged blast followed by 2 short blasts.

What sound signal may a vessel being towed make?

A vessel towed may give 3 blasts in succession, viz., 1 prolonged blast followed by 2 short blasts.

What sound signal must sailing vessels and boats of less than 20 tons gross tonnage make?

If they do not give the signal prescribed for other vessels, they must make some other efficient sound signal at intervals of not more than 1 minute.

Do the Regulations require vessels to take any other precaution during thick weather?

Yes. Art. 16 says every vessel shall, in a fog, mist, falling snow, or heavy rain storms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

What action must be taken by a steam vessel hearing apparently forward of the beam the fog signal of another vessel, the position of which is not ascertained?

She shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

How can you generally ascertain whether there is risk of collision in approaching another vessel?

By carefully watching the compass bearing of the other vessel, and if it does not appreciably change, such risk should be deemed to exist.

When a steam vessel under way takes any course required by these Rules, must she indicate that course to any vessel she has in sight?

Yes. Art. 28 provides that in taking any course authorised or required by the Regulations, a steam vessel under way shall indicate that course to any other vessel which she has in sight by the following signals on her whistle or siren, viz.:—

One short blast to mean "I am directing my course to starboard."

Two short blasts to mean "I am directing my course to port."

Three short blasts to mean "My engines are going full speed astern."

What does the expression "short blast" used in the preceding article mean?

It means a blast of about 1 second's duration.

What precaution is to be taken by steam vessels which are directed by these Rules to keep out of the way when approaching another vessel?

They shall, if necessary, slacken speed, or stop and reverse.

If you see two white lights in a vertical line one over the other, what do they denote as regards the vessel carrying them?

They may denote the presence of a steam vessel end on, with her side-lights not within sight on account of distance, fog, etc.; or a steam vessel towing, with her side-lights not within sight on account of distance, fog, etc.; or a vessel end on to me engaged in drift net fishing, or in line fishing; or it may be a steam trawler end on, or within 2 points of being end on, to me; or a vessel of 150 feet or upwards in length at anchor and end on to me.

If a steam vessel A sees another steam vessel's red light B on her own starboard side, are the steam vessels meeting, passing, or crossing, and how do you know?

Crossing, because the red light of one is opposed to the green light of the other; and whenever a green light is opposed to a red light, or a red light to a green light, the vessels carrying the lights are crossing vessels.

Is A to stand on; and, if not, why not?

A has the other vessel B on her own starboard side. A knows she is crossing the course of B because she sees the red light of B on her (A's) own starboard side. A also knows she must get out of the way of B, because Article 19 expressly requires that the steam vessel that has the other on her own starboard side shall keep out of the way of the other.

Is A to starboard or to port in such a case?

A must do what is right so as to get herself out of the way of B, and must, if the circumstances of the case permit, avoid crossing ahead of B.

If A gets into collision by altering her course to starboard, will it be because she is acting on any Rule?

No; the Rule does not require her either to alter course to port or to starboard.

If a steam vessel A sees the green light of another steam vessel B on her own (A's own) port bow, are the two steam vessels meeting, passing, or crossing; and how do you know?

Crossing, because the green light of one vessel is shown to the red light of the other.

What is A to do, and why?

By the Rule contained in Article 21 of the Regulations, A is required to keep her course and speed, subject to the qualification that due regard must be had to all dangers of navigation and collision; and that due regard must also be had to any special circumstances which may exist in any particular case, rendering a departure from that Rule necessary in order to avoid immediate danger. The crossing vessel B on A's port side must get out of the way of A, because A is on B's starboard side.

Are steam vessels to get out of the way of sailing vessels?

If a steam vessel and a sailing vessel are proceeding in such direction as to involve risk of collision, the steam vessel is to get out of the way of the sailing vessel unless the sailing vessel is overtaking the steam vessel.

What is to be done by A, whether a steam vessel or a sailing vessel, if overtaking B?

A is to keep out of the way of B.

When is a vessel considered to be an overtaking vessel?

Every vessel coming up on another vessel from more than 2 points abaft her beam, *i.e.*, in such a position, with reference to the vessel which she is overtaking, that at night she would

be unable to see either of that vessel's side-lights, is an overtaking vessel; and no subsequent alteration of the bearing between the two vessels can make the overtaking vessel a crossing vessel within the meaning of the Rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

In the daytime how do you know when you are an overtaking vessel?

It is often hard to judge with any degree of certainty, but if in doubt assume you are an overtaking vessel and keep out of the way.

METEOROLOGY.

Candidates should study the *Barometer Manual*, also the *Seaman's Hand Book on Meteorology*. Special attention should be given to the principle and construction of the various instruments.

The following are specimen questions as given at the Examinations. Generally six are set.

(1) What is the principle of the barometer?

The pressure of the atmosphere on the surface of the mercury in the cistern maintains the mercury in the tube at a height which corresponds to that pressure.

(2) What is the principle of the thermometer?

All substances expand with heat and contract with cold, but they do not all expand equally. Mercury expands more than glass, and so, when the thermometer is heated, the mercury in the bulb expands and rises in the tube in the form of a thin thread.

Boiling point equals 212°; freezing point, 32° Fah. Mercury freezes at minus 38·2° Fah.

Absolute zero is another measure of temperature which is 273° Centigrade below the freezing point of water, or minus 459·4° on the Fahrenheit scale.

The advantage of the absolute scale is that all negative values are avoided for meteorological work.

(3) Hygrometer. This instrument measures the humidity of the air. It consists of two thermometers placed near each other; one is a dry bulb thermometer and the other is a wet bulb. When the humidity of the atmosphere is

great (rain or fog) there is little or no evaporation and the two thermometers will read alike, but at other times the wet bulb thermometer reads lower than the dry one.

(4) What is the principle of the hydrometer?

It is based upon the well known principle that any floating body displaces a quantity of the fluid which sustains it, equal in weight to the weight of the floating body itself. The hydrometer is used for determining the specific gravity of fluids. The graduations extend from 0 to 40 . If the temperature of the water differs from 59°, it will then require a correction.

(5) What is the atmospheric pressure at sea level?

14·7 lbs. to the square inch, or 1000 millibars.

(6) What is a millibar?

A millibar is a unit of pressure; namely, $\frac{1}{1000}$th part of the ordinary atmospheric pressure at sea level.

(7) How can centibars be turned into millibars?

One centibar equals ten millibars; multiply the centibars by ten and you convert them into millibars.

Note.—In reading, this is done by moving the decimal point one place to the *right.*

(8) What is the length of a mercurial barometer?

About 33 inches.

(9) What is meant by the Torricellian vacuum?

It is the space left between the upper surface of the column of mercury and the top of the tube in the barometer.

(10) What are the corrections required for a barometer reading before it can be compared with a standard reading?

It should be corrected for index error (if any), also altitude, temperature and latitude.

(11) Describe a cyclone.

The wind in a cyclone blows round a central area of relatively low barometric pressure, the direction of revolution being opposite to that of the hands of a watch in the Northern Hemisphere; but with the hands in the Southern Hemisphere. The direction and strength of the wind depend upon the direction and steepness of the barometric gradient which may be defined as the difference in atmospheric pressure in hundredths of an inch for each 15 miles.

(12) What are the principal causes of wind?

Wind is air in sensible motion. It is caused by differences in the pressure of the atmosphere—the air moving from regions of relatively high to regions of low barometrical pressure. These changes of pressure are caused by differences in temperature and are brought about by rain, clouds, and unequal distribution of land and sea, etc.

(13) What causes the trade winds?

They are caused by the air being impelled from areas of high pressure towards the low pressure regions at the equator, also by the earth's rotation which in the Northern Hemisphere deflects the air currents to the right, and to the left in the Southern Hemisphere.

(14) What is a gust?

A gust is a sudden increase in the force of the wind.

(15) What is a squall?

A squall is a sudden increase in the force of the wind of greater duration and violence than a gust. They are both caused by the meeting of air of different temperatures

(16) What causes rain?

Rain is caused by a diminution in the temperature of the air below the point of saturation. When the minute

spherical drops of water, of which cloud is composed, become larger and heavier by the condensation of aqueous vapour and unite they fall as rain.

(17) Describe some of the reasons that cause a difference of barometric pressure in adjacent localities.

Geographical position principally, having regard to latitude, distribution of land and water, etc.

(18) What effect have temperature and wind on evaporation?

High temperature and a dry wind assist the process of evaporation.

(19) Describe a nimbus cloud.

A nimbus cloud is a black, low-lying sheet of cloud with ragged edges from which rain is almost always falling.

(20) Describe the typhoons of the China Sea.

Typhoons in the China Seas originate to the eastward of the Philippine Islands in the lower latitudes. The centres of the storms travel westward and recurve to the eastward and eventually reach the west coast of North America by way of Japan. The general track in July and August is to west, north-west, and north. In October and November from south-west to west and north-west.

(21) Lying in harbour and the indications point to the approach of a cyclone what precautions would you take?

Drop the second anchor and give a good scope of cable on both. Furl any canvas that may be set, but if you have sufficient sea room and time to get up steam, do so and proceed to sea.

(22) What are glaciers, where do they originate, and what becomes of them in tropical zones?

Glaciers are rivers of snow, which have their origin in elevated regions, and are compacted into ice. This compacted mass is urged downward by gravity and by the increasing pressure of the masses in the rear. When the glacier reaches the sea portions of the floating mass are severed from the parent glaciers and are called icebergs. As these icebergs drift towards the tropical zones they dissolve in the warmer water.

(23) What is a col?

A col is a neck of low pressure which forms between two areas of high pressure. It usually forms in summer with a higher temperature than normal, and in winter with a lower temperature. The weather is usually quiet but unsettled, with light, variable winds.

(24) Explain mist or fog.

Mist or fog is caused by the aqueous vapour in the atmosphere becoming visible, caused by its being cooled below the point of saturation. (Stagnation of the atmosphere.)

(25) What are squalls caused by?

Squalls are caused by the meeting of air currents of different temperatures either near the earth's surface or in the upper regions.

(26) Name the different gases in the atmosphere and give the percentage for each.

Nitrogen, 77·11%. Oxygen, 20·65%. Aqueous vapour, 1·40%. Argon, 0·79%. Carbonic acid, 0·04%.

(27) When will the sun's rays have its greatest effects, and state the reason why? Also, state any modifying influence.

When the rays are striking perpendicularly through the atmosphere, and as the declination never rises more than $23\frac{1}{2}°$ N. or S., the tropics have always a higher temperature. The temperature would therefore depend on latitude were it not for modifying effect of ocean currents, winds, etc.

(28) If you have reason to think that you are in the direct path of the storm's centre, what action will you take?

In the northern hemisphere I would run with the wind on the starboard quarter. In the southern hemisphere with the wind on the port quarter, until the barometer has ceased to fall.

The same rule is adopted for a steamer, as well as in that of a sailing ship.

(29) Describe a line squall.

A line squall is a V shaped depression of pressure passing over any area. As it passes the barometer commences to rise, and there occurs a brief increase of wind accompanied by rain, hail or snow.

(30) Define ice blinks.

An effulgence thrown off from the icebergs and seen in the sky in its direction. At short distances it has the appearance of a small cloud and denotes danger.

(31) What is gravity?

Gravity is an error for latitude to be applied to the barometer. If the latitude is above 45° the correction is additive, but if below 45° it is subtractive.

(32) What is capacity error?

The correction to be applied to the barometer reading. It is caused by the rise and fall of the surface of the mercury in the cistern.

(33) How is heat conveyed through the atmosphere?

By conduction, by conversion, and by radiation.

(34) What is capillary correction?

Mercury not having the same attraction for glass as water. There is a certain amount of friction set up, and this causes an error known as capillary error, and is always additive.

(35) Describe the effects of difference of temperature in adjacent localities on the equilibrium of the atmosphere.

When air is heated it expands and becomes lighter and consequently rises to higher regions of the atmosphere. The colder and heavier air then flows inwards from the surrounding districts to take the place of the ascending air and thereby restores the equilibrium of the atmosphere.

(36) State the effect of temperature and wind on evaporation.

High temperature and a dry fresh wind assist the process of evaporation.

(37) State Buys Ballot's Laws for the northern hemisphere.

Stand with your face to the wind and the barometer will be lower on your right hand than on your left.

(38) What is a barometrical gradient?

The difference of pressure expressed in hundredths of an inch of the mercury column in 15 nautical miles of distance.

(39) Describe isobaric lines.

Lines of equal barometrical pressure.

(40) What are the two principal things a mariner ought to know about cyclones and how are they determined?

The first thing a mariner should ascertain is how the centre bears, and second find what semi-circle he is in. Face the wind and the centre of the cyclone will bear from 12 to 8 points on the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

(41) What causes mirage?

Mirage is caused by rays of light passing through different layers of air, having unequal density, and causes a displacement of the horizon through refraction.

(42) Describe halos and how they are formed.

Halos are circles showing, when well developed, prismatic colours around the sun or moon; but when they are of slight intensity they appear white. They are caused by refraction and reflection from ice crystals in cirrus clouds.

(43) Describe a cumulus cloud.

Cumulus cloud is thick cloud of which the upper surface is dome shaped, while the base is horizontal. It presents the appearance of a cauliflower.

(44) Describe the characteristics of icebergs in the Southern Hemisphere.

The majority of icebergs in the Southern Hemisphere are tabular in form and originally formed part of an ice barrier. They are remarkable for their great length.

(45) What is the origin of the term cyclone?

The term cyclone is derived from a Greek word signifying the coil of a snake. It was first suggested by Piddington in the year 1848.

(46) What is the dangerous and navigable semi-circle of a tropical revolving storm in the Northern Hemisphere?

The dangerous semi-circle in the Northern Hemisphere is the right hand semi-circle, and the navigable semi-circle is the left hand semi-circle.

DERRICKS AND HEAVY WEIGHTS.

The Parallelogram of Forces.

When two forces act on a point along different lines, their resultant is found by the following rule, which is called the principle of the parallelogram of forces.

If two forces act on a point, and if lines be drawn from that point, representing those forces both in magnitude and direction, and on those lines, as sides, a parallelogram be constructed, their resultant will be represented, both in magnitude and direction, by that diagonal which passes through the point.

A knowledge of the above principle is useful in calculating the stresses put upon the cargo gear, especially when dealing with heavy weights.

Consider the load or pull upon a shackle attached to a derrick head when supporting any weight. It is evident that should the weight be simply hanging from the shackle by a line attached to the weight, the pull on the shackle is simply that of the weight.

When the weight is held by a runner, rove through a single block at the derrick head and led, for example, down the derrick to a winch, an equal weight is now opposed to the original weight to support it and the pull on the derrick head shackle has been considerably increased.

In lifting the weight, it is necessary to apply a force to the hauling part of the fall to overcome the downward pull of the weight and the friction on the pin of the sheave of the block.

As explained, on page 90, it is usual to allow for friction by increasing the weight to be lifted, by one-tenth of the weight for every sheave in use.

The following example should make the matter clear.

A derrick is at an angle of 30° to a mast and is supported by a span which is at right angles to the mast. A single runner is led through a block, shackled to the derrick head, down the derrick to a winch. If the weight to be lifted is 1 ton and assuming a force is being exerted to just move the weight, find by a diagram:—

(*a*) The load on the shackle at the derrick head.
(*b*) The thrust in the derrick.
(*c*) The tension on the span.

Making use of the formula $S = \frac{W+F}{P}$

where S = the load or pull on the hauling part.

F = friction or $\frac{nW}{10}$

n = number of sheaves in use

W = weight to be lifted

P = power of the purchase

we obtain $S = \frac{1 \text{ ton} + \frac{1}{10} \text{ of } 1 \text{ ton}}{1}$ *i.e.* $\frac{11}{10}$ tons or 22 cwt.

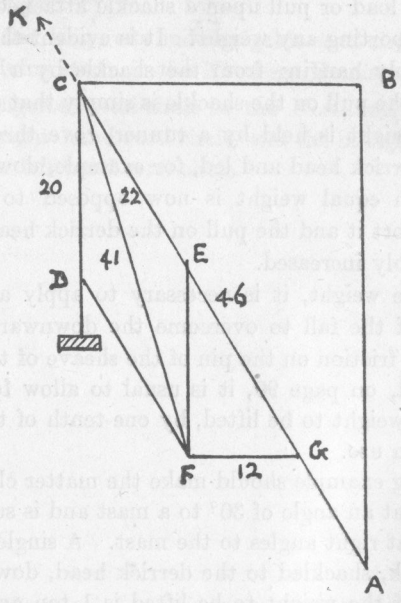


DIAGRAM 1. SCALE $\frac{1}{20}$" = 1 CWT.

In diagram No. 1.

AB represents the mast
AC „ derrick
BC „ span

Make *CD* equal in length to 20 units (20 cwt.)
„ *CE* „ „ 22 „ (22 cwt.)

Draw *EF* parallel to *CD* and *DF* parallel to *CE* to complete the parallelogram. The diagonal *CF* represents the pull on the shackle of the head block (41 cwts.)

Draw *FG* parallel to *CB* then *FG* represents the tension on the span (12 cwts.) and *CG* represents the thrust in the derrick (46 cwts.)

An extension of the principle of the "Parallelogram of Forces" leads to what is known as the principle of the "Triangle of Forces" in which, if a point is in equilibrium under the action of three given forces and a triangle be drawn with sides respectively parallel to these three forces, the lengths of the sides are proportional to the forces themselves.

This often leads to simplification of a problem and is used in Diagram 1 in finding the thrust in the derrick and the tension in the span.

Thus, the shackle at the derrick head is in equilibrium under the action of the following three forces:

(*a*) The pull on the shackle in the direction *CF*.
(*b*) The thrust of the derrick in the direction *CK*.
(*c*) The tension in the span in the direction *CB*.

By drawing *FG* through *F* parallel to the span *CB* to cut the derrick in *G* the triangle *CFG* thus becomes a triangle of forces.

The length of *CG* therefore represents the thrust in the derrick and the length of *FG* the tension in the span.

It has already been stated, on page 94, that the power of any purchase is measured by the number of parts of rope at a moving block. When dealing with heavy weights it is

not unusual to have 3, 4 or even 5 fold purchases and this considerably lessens the power required to be exerted and also makes it possible to use smaller size ropes. Ships engaged in carrying heavy weights are generally fitted with a heavy derrick at each mast, the stronger one being on the after part of the foremast. They must have a special fitting to support the heel, and the deck in the vicinity has to be considerably strengthened.

The topping lift for such a derrick is usually a 3 or 4 fold wire purchase, as is also the main purchase for lifting and lowering the weight.

It is also usual to have the hauling part of the main purchase leading from the lower block, then through a lead block near the derrick head (sometimes an internal sheave is fitted in the derrick) next through a lead block at the masthead and then through the heel block to the winch. In some cases the fall, after passing through the lead block at the masthead, is taken to a special winch on the foc'sle-head and thus relieves the mast and derrick of a good deal of weight.

The derricks must have good, strong guys to control them, and in addition to the usual standing rigging on the mast, preventer stays are led forward to the foc'sle-head, one on each side of the deck, and set up taut.

Consider an example of a 15 tons weight being lifted, using a 3 fold purchase, but with the hauling part coming from the upper block and leading horizontally to a block attached to the mast and then through the heel block to the winch.

The derrick makes an angle with the mast of 40° and the topping lift is at an angle of 70° to the derrick.

It is required to find.

(*a*) The stress on the shackle of the upper purchase block.

(*b*) The thrust in the derrick.

(*c*) The tension on the topping lift.

In this case, the power of the purchase is 6 (the number of parts of rope at the moving block. There are 6 sheaves in the purchase

and 2 lead blocks. As the direction of the fall at the masthead block is practically a right angle and more than a right angle at the heel block, the friction at these two blocks is much reduced. We may consider them as counting for one more sheave and work out the problem with $\frac{7}{10}$ths of the weight for friction.

$S = \frac{W+F}{P}$ where S = the load or pull on the hauling part.

$F = \frac{nW}{10}$ for friction.

n = number of sheaves to be considered.

W = weight being lifted.

P = power of the purchase.

$W = 15$ tons, $F = \frac{7}{10}$ of 15 tons $= 10{\cdot}5$ tons.

$\therefore\ S = \frac{15+10{\cdot}5}{6} = \frac{25{\cdot}5}{6}$ or 4·25 tons.

In the diagram (No. 2).

AB represents the mast.

BC ,, topping lift.

AC ,, derrick.

CD is made 15 units in length (15 tons).

CE is made 4·25 units in length being the force exerted in the direction of the fall from the derrick to the mast.

Complete the parallelogram $C\ E\ F\ D$ and draw the diagonal $C\ F$. Draw $F\ G$ parallel to the topping lift.

CF represents the pull on the derrick head block (15·3 tons.)

CG ,, thrust in the derrick (16·5 tons).

FG ,, tension on the topping lift (6·5 tons).

From the equation in the preceding example can be found the size of a special flexible steel wire containing 24 wires to each of the six strands and of which the safe working load is $\frac{3\ C^2}{5}$

$$\frac{3\ C^2}{5} = 4{\cdot}25$$

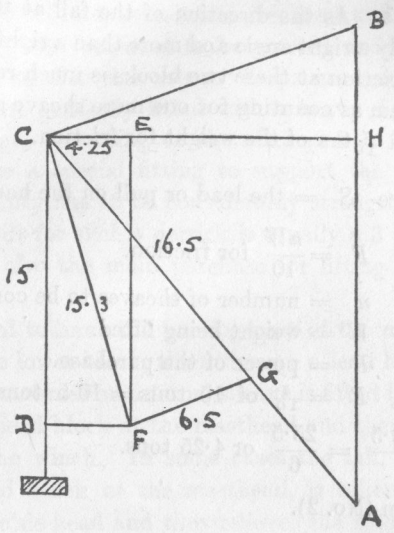


DIAGRAM 2. SCALE $\frac{1}{16}$" = 1 TON.

$$\therefore\ C^2 = \frac{4{\cdot}25 \times 5}{3} \text{ i.e. } \frac{21{\cdot}25}{3} \text{ or } 7{\cdot}08$$

$$\therefore\ C = \sqrt{7{\cdot}08} \text{ or } 2{\cdot}65 \text{ inches}$$

A $2\frac{3}{4}$ inch rope should therefore be used.

Note.—In these examples no allowance has been made for the weight of the cargo gear.

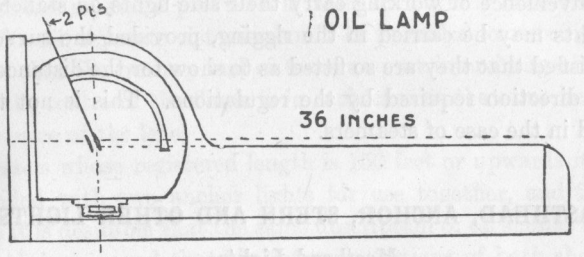
It has been assumed that the force used has been just sufficient to move the weight slowly.

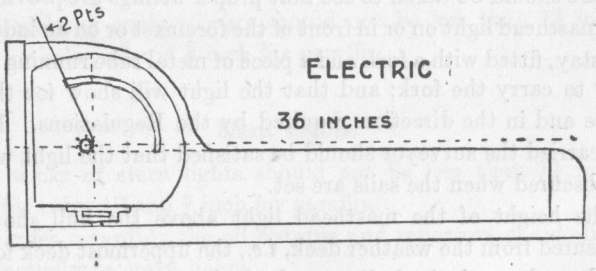
If instead of just moving the weight slowly, it is accelerated, a further force is necessary to produce the acceleration and would affect the results.

The greater the angle between the derrick and the mast the greater becomes the tension on the span although the thrust in the derrick is slightly decreased.

Screening of Side-Lights.

The wick or wicks of a side-light must be placed at an angle of $112\frac{1}{2}°$ with the fore-and-aft line of the ship; in other words, they must be parallel to the direction 2 points abaft the beam. The burner must be so placed that a line drawn in this direction from the after edge of the wick in the case of a single burner, and of the forward wick in a duplex burner, shall cut the edge of the housing of the lens. (*See* plate.)





The screens of side-lights, the length of which should never be less than 36 inches from the flame to the chock or its equivalent, must always be parallel to the line of the keel. The chocking must be so arranged to show a thwartship value of at least 1 inch of wick in a forward direction.

With electric side-lights the lamp sockets must be placed in

the lantern cases that a line drawn in a direction 2 points abaft the beam touching the forward edge of a circle $\frac{5}{8}$ inch in diameter concentric with the socket will cut the edge of the housing. The centre of the lamp socket should be placed $\frac{5}{16}$ inch abaft the centre from which the curvature of the lens is struck. (*See* plate.)

Lights in the Rigging.

In the case of small sailing vessels which cannot with safety and convenience of working carry their side-lights on stanchions, the lights may be carried in the rigging, provided the surveyors are satisfied that they are so fitted as to show for the distance and in the direction required by the regulations. This is not to be allowed in the case of steamers.

MASTHEAD, ANCHOR, STERN AND OTHER LIGHTS.

Masthead Lights.

Care should be taken to see that proper fittings are provided for the masthead light on or in front of the foremast or on an independent stay, fitted with a fork and a piece of metal tube running up the stay to carry the fork; and that the light will show for the distance and in the direction required by the Regulations. If sails are carried the surveyor should be satisfied that the light will not be obscured when the sails are set.

The height of the masthead light above the hull should be measured from the weather deck, *i.e.*, the uppermost deck forming the boundary of the hull or underdeck tonnage.

The rules regarding the minimum dimensions of the lantern, the oil cisterns, wicks, wickholders, and position of the luminous part of the flame of side-lights apply to masthead lights, except that the wickholder need not be fixed at right angles to the fore-and aft line of the ship; such an arrangement is, however, desirable.

Masthead lights should be fitted with reflectors. The surveyors

should, however, be careful to see that they are not of such size and form as to intercept any of the direct rays of light which should fall upon the lens.

The power and character of a masthead light should not be such as to give it the appearance of a shore light.

Anchor Lights.

The diameter of the lenses of anchor lights should not be less than 8 inches, and if provision is made for burning both colza and paraffin oil, separate cisterns should be provided, care being taken to see that the burners and cisterns are not interchangeable, and that the centre of the flame is in each case at the same height as the centre of the lens.

Vessels whose registered length is 150 feet or upwards must be provided with two anchor lights for use together, and in such cases it is desirable that the same description of oil should be used in both lamps, and that the internal portions of both should be alike in all respects.

The wicks of anchor lights should not be less than $1\frac{1}{4}$ inches broad for colza oil and $\frac{3}{4}$ inch for paraffin.

Stern Lights.

The wicks of stern lights should not be less than $1\frac{1}{4}$ inches broad for colza oil and $\frac{3}{4}$ inch for paraffin.

The rules regarding the oil cisterns and reflectors of side-lights apply equally to stern lights.

Not-under-command Lights.

The two red lights prescribed by Article 4 of the Collision Regulations for the use of vessels which are not under command are required to be visible for the same distance as side-lights, viz., at least 2 miles.

The wicks of these lamps should in no case be smaller than those specified for side-lights, and, as reflectors cannot be fitted, wicks of greater width than the minimum laid down in paragraph 19 will be required unless the lenses and burners are of superior design and quality.

The lenses may be either spherical or cylindrical. No special size need be insisted on, but if the diameter is less than 10 inches the surveyors should take steps to satisfy themselves that the ventilation of the lantern is sufficient to prevent it from becoming unduly heated.

The colour of the lenses or coloured slides, if the latter are used, should not differ materially from that required for the port side-light.

Coloured chimneys should not be passed by the surveyors for lights indicating that a vessel is not under command.

Lights of Small Vessels

In the case of vessels coming under Article 7 of the Regulations, the standard size of lamp need not be insisted on, provided the lamps supplied comply with the Collision Regulations, and are of such size as to afford sufficient ventilation and to continue burning without undue heating.

SOUND SIGNALS.

Bells.

All steam and sailing vessels must be provided with an efficient bell. The bell should be hung clear of all obstructions, and should not be less than 12 inches in diameter.

Steam Whistles.

All steam vessels and all vessels propelled by machinery on the high seas and in all waters connected therewith navigable by sea-going vessels are required to be provided with an efficient whistle or siren, sounded by steam or some substitute for steam, and so placed that the sound may not be intercepted by any obstruction. The whistle should be at least 8 feet above the deck, forward of the foremost funnel and well clear of deck-houses, ventilators, etc.

Whistle pipes should be so arranged that a full supply of dry steam will at all times be immediately available when the vessel is under way, and, to insure this, if it is possible for water to lodge in the pipes, automatic or other efficient drains which can always be kept open should be fitted.

The pipes should not, as a rule, except in small vessels, be less than 2 inches, outside diameter, and should be lagged at least up to the deck.

The whistles of all new vessels should be tried, and unless a full, clear, sounding blast is immediately produced under all circumstances, they should not be passed.

COLLISION REGULATIONS—AIRCRAFT

Under the International Collision Regulations, aircraft on the surface of the water are within the definition of "steam vessels." As such, they are required to carry lights, make sound signals and manœuvre, both in respect of surface vessels and of each other, in a manner that is not, in some instances, possible for

them, due to the physical limitations of aircraft. At the same time, they can and should take upon themselves some definite measure of responsibility for the avoidance of collisions between surface vessels and aircraft on the surface of the water, and it is necessary that their rights and duties, when on the surface of the water, should be defined.

Whistles on Motor Boats.

Vessels fitted with electric or oil motor engines, whether auxiliary or otherwise, for propelling purposes are steam vessels within the meaning of the Collision Regulations, and should therefore be provided with an efficient whistle or siren sounded by steam or some substitute for steam.

If, however, a surveyor is satisfied that it is impracticable to fit a whistle on any particular vessel of this description he need not detain the vessel, provided an efficient horn, or an efficient electric bell, is on board, and if fixed is so placed that the sound from it will not be unduly obstructed.

In the case of motor vessels plying on rivers or lakes a horn or electric bell, audible for at least $\frac{1}{4}$ of a mile, may be allowed instead of a whistle, if the owners so desire.

Fog Horns.

A proper mechanical fog horn, of good power, should be provided in both steam and sailing vessels. The fog horn may be such that it can be blown by steam, or it may be a horn that can be blown by hand. It should be of some approved pattern known to emit great and penetrating sound, and it should always be tried.

If a fog horn is fitted to be blown by steam or substitutes for steam it must be supplemented by another to be blown by hand, unless the steam fog horn can be used also by hand.

As, except in the case of sailing vessels and boats of less than

20 tons gross, the signals to be given on the fog horn include "prolonged blasts" of from four to six seconds' duration, all fog horns should be capable of producing a blast of at least four seconds' duration.

Fishing Vessels.

The lights and means for making fog signals on fishing vessels will require careful inspection. Special rules are laid down in Article 9 of the Order in Council of 13th October, 1910, as to the lights to be carried by the different classes of fishing vessels when they are fishing or at anchor, and as to the fog signals to be made. When fishing vessels are underway and are not engaged in fishing, they must carry the lights prescribed for vessels of their tonnage underway.

If working lights are used they should be screened in such a manner that they cannot be mistaken for navigation lights.

Mouth fog horns are not efficient and should not be allowed.

An 8-inch bell need not be insisted on in the case of the smaller vessels, but the surveyor should be satisfied that the bell provided is efficient.

The form to be used for issuing reports of inspection of the lights and fog signals of fishing vessels is Survey 69a.

The tricoloured lanterns carried by steam fishing vessels when engaged in trawling have been found in some cases to be made with vertical metal bars, which form the setting for the lenses, of such undue width as to prevent the coloured lights being visible, in the directions adjacent to the bars, over the required distance of 2 miles.

The total width of each metal bar forming the setting should not exceed $\frac{1}{4}$ to $\frac{5}{16}$ inch unless the lenses are of first quality and the light or flame is fully above the average power.

In some cases where coloured slides have been fitted in lanterns having dioptric lenses, the metal frames at the inner ends of the

slides have not been in the same radial line as the metal bars of the dioptric lenses, thus virtually increasing the width of the bars.

JURY RUDDER.

A jury rudder can only be used in fine or moderate weather; bad weather it must be taken on board. In a steamer it must e hoisted clear of the water when the vessel is going astern.

Many different sorts of jury rudders may be constructed; it depends on the material at hand, and the resource and ability of the man who is making it. In order to satisfy the Examiner you must show that you have a practicable knowledge of the work, and the following method will assist you.

Get a good spar, cut it the required length, and make the lower part of the spar in the shape of a large oar, with deals or strong planks, nailed and bolted firmly together; have some weight, such as a small kedge, or two small anchor stocks, securely made fast to the oar blade (the iron will keep it down in the water). Next pass a chain down through the rudder trunk, bring the end over the stern and make it fast on the fore lower part of the blade; also make fast two wire guys, one on each side on the fore-part of the blade. Have a strong spar across the stern, firmly made fast, reeve off a purchase and make fast the upper block amidships on the athwart-ship spar, and the lower block a few feet above the rudder blade. When all is ready, hoist it over with the 'midship tackle, and fix it in position with the guys and rudder-trunk chains. Next have a good wire strop around the middle of the athwart-ship spar, and over the head of the rudder; this, with the two lower guys and upper guys, will keep the rudder in position. A tiller should now be made with a handy spar, lashed figure eight fashion around the upper end of the oar, and the vessel may then be steered with two tackles made fast to the tiller.

Heaving a Keel Out—Heaving Down.

Before heaving down either to a hulk or a wharf, all arrangements should be made for the necessary repairs, floating stages, men, gear, etc., so that operations may be commenced immediately the vessel is hove down.

Moor the vessel's head and stern. Send down everything to the lower-masts. Come up the rigging on the side which is to be hove down and set the rigging up on the other side, knocking out the wedges around the partners to allow the masts to go over, shore up the lower masts, with the topmasts, or lower-yards on the heaving down side, from the water-ways to underneath the trestle-trees, and set taut the lee rigging. Get the pumps placed down the main hatchway for pumping out any water which may leak into the holds. Secure any ballast which may be in the ship, also everything movable about the decks.

If a steamer, shore up, and secure all the machinery and boilers, close up and caulk down all the openings.

Have the hulk moored in position, about 80 feet from the ship; two large four-fold purchase blocks should now be lashed to the lower mastheads, and similar blocks must be lashed to the hulk; next reeve off the purchase, viz., a steel wire hawser and steady the fall taut by the windlass on board the hulk; then pass two chains underneath the vessel's bottom, and make them fast on the upper side of the ship, also to the hulk—these chains are to be used as a preventive to keep the vessel from going over; when all is ready, heave on the main purchase and pay attention to the hulk's moorings, as it may be necessary to slack them off as the vessel goes over.

When she is hove down far enough, belay everything and get the repairs commenced as soon as possible.

When the work is completed great care must be exercised when raising the vessel so that both purchases may bear an equal

strain. Generally the purchase to the main-mast is the heaviest, and consequently can bear the greatest strain.

Dry Dock.

Before entering dock the chief officer should have a list of repairs checked by the master. The vessel's draught and full particulars should be sent to the dockmaster, with a note of any special repairs. The vessel should be upright and steadied on the blocks with masthead tackles, and properly shored off. In the event of the keel being damaged, blocks should be left out from under the damaged part, and it might be necessary to shore up the bilges.

Attend to the repairs, and see that her bottom is clean and dry before allowing the workmen to put on the paint. Have the rudder examined, wheel chains passed through the fire and tested; water tanks cleaned, sluices and rose-boxes examined; also the cables hove out, ballast tanks carefully examined, and all sea cocks and valves under the water line overhauled.

Note in the log book time of entering, and time of leaving dock, also all repairs, etc.

LOAD LINES.

International Convention respecting Load Lines 1930.

The following rules apply to all ships except—ships of war, ships solely engaged in fishing, pleasure yachts and ships not carrying cargo or passengers, ships of less than 150 tons gross.

When a ship has been surveyed and marked a certificate is issued which expires at the end of five years, when a further survey is necessary to enable the ship to receive a renewal of the certificate.

Freeboard.—The freeboard assigned is the distance measured vertically downwards at the side of the ship amidships from the upper edge of the deck line to the upper edge of the load line mark.

Freeboard Deck.—The freeboard deck is the deck from which the freeboard is measured, and is the uppermost complete deck having permanent means of closing all openings in weather portions of the deck.

Deck Line.—The deck line is a horizontal line 12 inches in length and 1 inch in breadth. It is to be marked amidships on each side of the ship, and its upper edge is to pass through the point where the continuation outwards of the upper surface of the freeboard deck intersects the outer surface of the shell (see figure). Where the deck is sheathed, the upper edge of the deck line is to pass through the point where the continuation outwards of the upper surface of the actual sheathing at amidships intersects the outer surface of the shell.

Load Line Disc.—This is to be 12 inches in diameter and is intersected by a horizontal line 18 inches in length and 1 inch in breadth, the upper edge of which passes through the centre of the disc. The disc is to be marked amidships below the deck line.

Lines to be Used in connection with the Disc.

The lines which indicate the maximum load line in different circumstances and in different seasons, are to be horizontal lines, 9 inches in length and 1 inch in breadth, which extend from, and are at right angles to, a vertical line marked 21 inches forward of the centre of the disc (see figure).

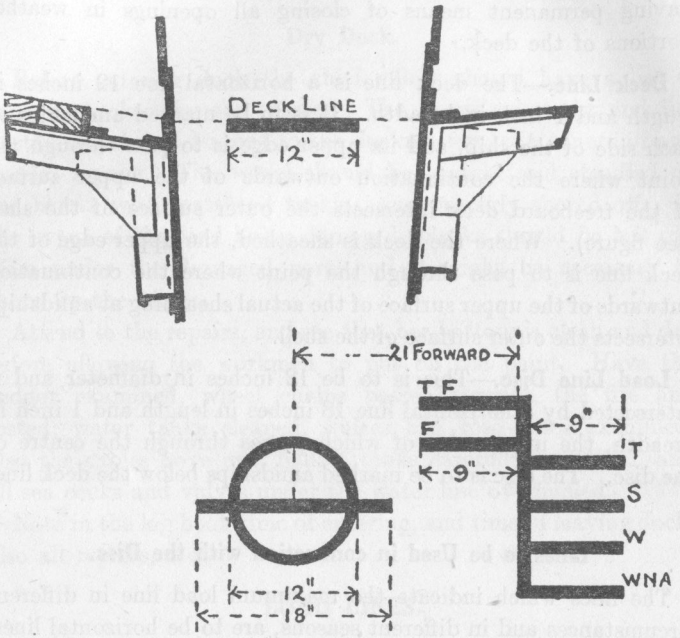
The following are the lines to be used:—

Summer Load Line is indicated by the upper edge of the line which passes through the centre of the disc and also by a line marked *S*.

Winter Load Line is indicated by the upper edge of a line marked *W*.

Winter North Atlantic Load Line is indicated by the upper edge of a line marked *W N A*.

Tropical Load Line is indicated by the upper edge of a line marked *T*.



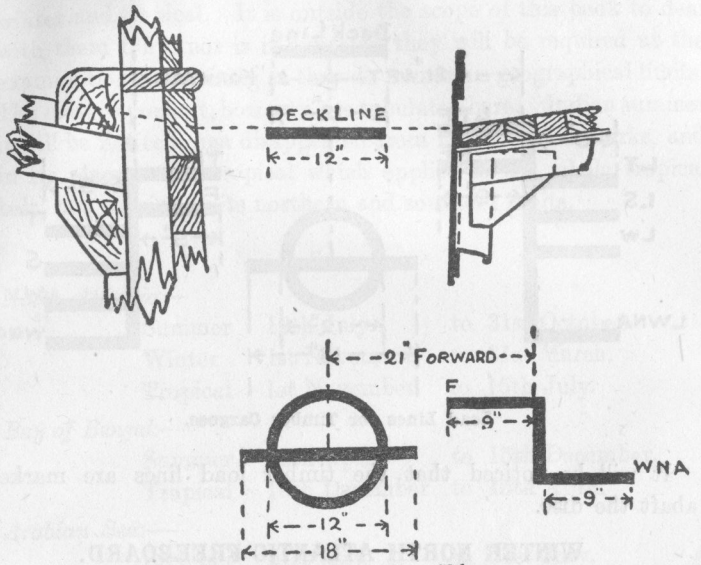
Load Line for Steamships.

Fresh Water Load Line in summer is indicated by the upper edge of a line marked *F*. The difference between the fresh water load line in summer and the summer load line is the allowance to be made for loading in fresh water at the other load lines. The *Tropical Fresh Water Load Line* is indicated by the upper edge of a line marked *T F*.

Load Lines for Sailing Ships

Winter and Tropical Load Lines are not marked on sailing ships. The maximum load line to which sailing ships may be laden in

salt water in winter and in the tropical zone is the centre of the disc (see figure).



Load Lines for Sailing Ships.

Timber Load Lines.

The Summer Timber Load Line is indicated by the upper edge of a line marked *L S*.

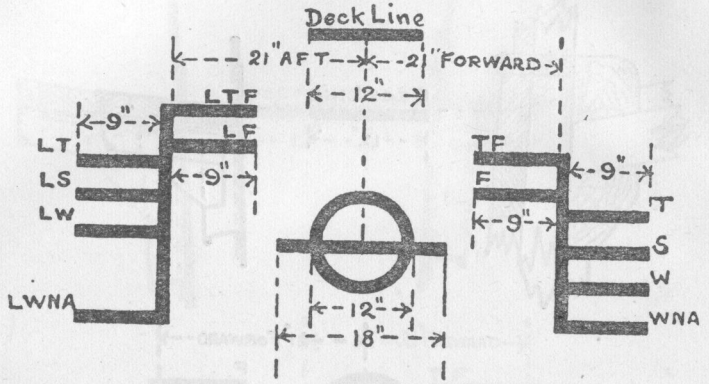
The Winter Timber Load Line is indicated by the upper edge of a line marked *L W*.

The Winter North Atlantic Timber Load Line is indicated by the upper edge of a line marked *L W N A*.

The Tropical Timber Load Line is indicated by the upper edge of a line marked *L T*.

The Fresh Water Timber Load Line in summer is indicated by the upper edge of a line marked *L F*.

The Fresh Water Timber Load Line in the Tropical Zone is indicated by the upper edge of a line marked *L F T.*



Load Lines for Timber Cargoes.

It will be noticed that the timber load lines are marked abaft the disc.

WINTER NORTH ATLANTIC FREEBOARD.

The minimum freeboard for ships not exceeding 330 feet in length on voyages across the North Atlantic *North of Latitude* 36° *N.* during the winter months is the winter freeboard plus 2 inches, for ships over 330 feet in length and it is the winter freeboard.

Tankers, however, are to load with a freeboard plus an addition of 1 inch per 100 feet in length.

All lines, discs and letters are to be painted in white or yellow on a dark ground or in black on a light ground. They are also to be carefully cut in or centre punched on the sides of iron and steel ships and on wood ships they are to be cut into the planking for at least $\frac{1}{8}$ of an inch.

The penalty for altering or defacing the marks or for overloading is a fine not exceeding £100.

ZONES AND SEASONAL AREAS.

The oceans have been marked off in different zones, summer, winter and tropical. It is outside the scope of this book to deal with them fully, nor is it expected they will be required at the examination, comprising as they do numerous geographical limits. The most important, however, are tabulated here. Indian summer it will be noticed, has disappeared from the load line marks, and in its place is the tropical which applies to the whole tropical belt, but varying in its northern and southern limits.

Seasons.

North Atlantic:—			
	Summer	16th July	to 31st October.
	Winter	1st November	to 31st March.
	Tropical	1st November	to 15th July.
Bay of Bengal:—			
	Summer	16th April	to 15th December.
	Tropical	16th December	to 15th April.
Arabian Sea:—			
	Summer	21st May	to 31st July.
	Tropical	1st August	to 20th May.
China Seas:—			
	Summer	1st May	to 20th January.
	Tropical	21st January	to 30th April.
North Pacific:—			
	Summer	1st November	to 31st March.
	Tropical	1st April	to 31st October.
South Pacific:—			
	Summer	1st December	to 31st March.
	Tropical	1st April	to 30th November.

SECTION V.

SHIP'S BUSINESS
MASTER'S CIVIL AND LEGAL DUTIES
LIFE-SAVING APPLIANCES, ETC.

SHIP'S BUSINESS.

Master's Civil and Legal Duties.

CERTIFICATE OF REGISTRY.

Ship's Register.

THE ship's register is a certificate which contains the vessel's name, tonnage, dimensions, also the owner's name and all other particulars relating to the vessel. It is used for clearing and entering the ship at the Customs both at home and abroad.

If you are appointed master of a vessel you must call at the Custom House with your certificate, and have your name placed on the register, or abroad, at the British Consul's office.

Engagement of the Crew.

The master must produce his own certificate, and the certificates of the officers and engineers who are signing on the Articles; also the ship's register, freeboard certificate, and crew space certificate. The general terms of the Articles are the intended voyage, stating the period of the engagement, number of the crew, wages, scale of provisions, capacity in which each man is to serve, the date and time at which each member of the crew has to be on board, regulations as to conduct, fines, etc. The Articles of Agreement must be on an official form approved by the Board of Trade. (Form Eng. 1. simply means the engagement, or Articles; Form Eng. 2. means the Return List). Two copies of the Articles are signed; the master keeps one copy, and the other is retained by the superintendent. The master also receives an abstract copy, which must be posted up in some conspicuous part of the

vessel which is accessible to the crew. Failing to do so renders the master liable to a fine not exceeding £5.

When the crew are duly signed on, the superintendent grants to the master the **A A** Certificate, which he must show to the Custom House officials when clearing his vessel outwards. The master also receives the official log, articles, account of wages book, and return list. The return list (Form Eng. 2) must be duly filled up, showing the changes in the crew (if any) since the Articles were signed, also the names of substitutes (if any) for those who have failed to join.

OFFICIAL LOG.

The official log is a book issued by the Board of Trade, to make entries relating to the ship, crew, and passengers.

The master is entirely responsible for the official log, and must see that it is properly kept and the necessary entries made.

The following are the principal entries:—Boat drill, also the day and date when the life-saving appliances are inspected; draught of the vessel on leaving port, also on arrival, and the freeboard; list of the crew and their character; any change of the crew during the voyage; every case of sickness and the treatment given; the amount of wages due to any seaman who may enter His Majesty's service; the wages due and list of effects belonging to any member of the crew who dies during the voyage; also full particulars of any passenger who may die during the voyage; offences by any member of the crew and the fines inflicted; collisions, strandings, etc.

Any entry in the official log must be made as soon as possible after the occurrence to which it relates, and all entries must be dated, and signed by the master and chief officer, or by a junior officer, or some other member of the crew.

In the case of illness, or death, have the entry signed by the doctor, if there is one on board.

If you log any member of the crew, the entry must be read over to the man, and his reply, if any, duly entered and signed by the

master and a witness. All entries must be made within 24 hours of the arrival of the vessel at the final port of discharge.

Discharging the Crew.

At the end of the voyage the crew must be paid off within two clear days; Sundays and holidays are not counted. At the end of the engagement the master is bound to pay each seaman £2 sterling, or one quarter of the amount of wages due to him, whichever is least. The master should give each man an account of his wages, and also deposit his Articles and official log within 48 hours of his arrival, or when paying off the crew if that takes place within 48 hours.

After the Articles are closed the superintendent must deliver to the master a certificate to that effect—which is called the **B B** form.

CUSTOMS.

Entering Inwards.

The master must on arrival, or within 24 hours, at any port of the United Kingdom report his vessel to the collector of Customs before breaking bulk, under a penalty of £100. The necessary papers are ship's register, manifest of cargo and stores, last light bill, pratique certificate, report list, and if grain laden, the grain certificate.

When the cargo is all discharged the Customs send an officer to rummage the vessel and check the stores, etc. The master then produces the **B B** certificate, and receives the inward clearing bill, or jerque note.

Entering Outwards.

No cargo can be shipped until such time as the ship is entered outwards at the Customs. The necessary documents are the register and receipt for the outward light bill.

The **A A** certificate is granted to the master of a foreign-going vessel by the superintendent of the shipping office; it certifies that he has signed on his crew and complied with all the regulations of

the shipping office. The **A A** must be shown at the Customs when clearing outwards. On a home-trade vessel the **C C** certificate must be shown. The **B B** certificate is granted by the superintendent of the shipping office to the master of a vessel when he has deposited his ship's articles, official log, and paid off his crew, and complied with all the requirements of the shipping office.

Light Dues.

Light dues is a charge made on vessels for the up-keep of lighthouses, lightvessels, buoys and beacons, etc. Vessels calling for bunkers only are exempt. A vessel will be detained by the Customs unless the receipt for light dues is produced.

Transire.

A Custom House warrant for permitting goods to pass.

SEAMEN AND FOOD.

Seamen must have a knowledge of the English language. If the master fails to furnish provisions, or furnishes food deficient in quality, he is liable to a penalty of £100, and compensation to the crew. If the master obstructs the inspector of provisions, he is liable to a penalty of £10; and if he fails to comply with the requirements as to a certificated cook he is liable to a penalty of £25.

Seamen's Effects.

The master must make the proper entry in log as to wages and effects of seamen left behind abroad, and delivery at end of voyage of accounts, effects, and balance shown by accounts, under a penalty of £20.

Seamen.

Seamen are entitled to allotment if they require it, and must also be given facilities for remitting, under a penalty of £5.

Disrating Seamen.

On disrating a seaman you must give him a copy of the entry in the log; reading it over will not be sufficient, and reduction of wages will not take effect until the copy has been handed to the seaman who has been "logged."

CARRIAGE OF GRAIN.

Where a grain cargo is laden on board any British ship, all necessary and reasonable precautions shall be taken in order to prevent the grain cargo from shifting.

If those precautions have not been taken, the master of the ship and any agent of the owner who was charged with the loading of the ship, or the sending her to sea, shall each be liable to a fine not exceeding £300.

When is a ship laden with grain?

The expression "ship laden with a grain cargo" means a ship carrying a cargo, of which the portion consisting of grain is more than one-third of the registered tonnage of the ship, and that third shall be computed, where the grain is reckoned in measures of capacity, at the rate of one hundred cubic feet for each ton of registered tonnage, and where the grain is reckoned in measures of weight, at the rate of two tons weight for each ton of registered tonnage.

Grain is corn, rice, paddy, pulse, seeds, nuts, or nut kernels.

The laws on carriage of grain apply to vessels loading in the Mediterranean and Black Sea bound outside the Straits of Gibraltar, also to vessels loading on the coast of North America.

A Grain Certificate is an official document which is filled in by the master before leaving the final port of loading, stating how the grain is stowed and quantity on board; also the precautions taken to prevent it from shifting; draught of water and freeboard.

If the master fails to deliver the certificate, or makes a false statement, he is liable to a fine not exceeding £100.

MASTERS' LEGAL DUTIES.

Survey.

In the case of a survey the master's presence is always required. Have two competent persons according to the nature of the damage (such as two shipmasters, two engineers, carpenters, or a shipmaster and merchant) to examine the damage; they give a written report on the case, and when the repairs are all finished hold another survey and get the surveyors to sign a document to the effect that all the repairs were properly carried out. The surveyors must be disinterested parties.

Survey of Cargo.

The hatches ought to be surveyed before they are taken off, in the presence of the master and surveyors.

When discharging cargo, if a quantity is damaged it ought to be surveyed before being removed, so that the surveyors may see for themselves that it has been properly stowed and dunnaged.

Bottomry Bond

Is a bond by means of which a vessel is pledged as security for money advanced to enable the vessel to proceed to her port of destination. The bond can only be raised when it is impossible to get money on credit; it should be advertised for and the lowest rate of interest accepted, and the money can only be expended on what is absolutely necessary to enable the ship to complete her voyage.

If it is necessary to raise more than one bond, the last bond is always repaid first.

If the vessel is lost before arriving at her port of destination, the lender loses the money advanced and interest.

If the vessel arrives the bond and interest are paid.

Respondentia.

If you cannot obtain a bottomry bond, then raise enough money by selling the cargo so as to get repairs done to enable the vessel to complete the voyage.

Warranty.

A clause in a policy stating that the vessel must not deviate from the voyage, etc.

Bills of Lading.

A bill of lading is a stamped document signed by the master for goods received on board, the said goods to be delivered at the port of destination. It must have an impressed sixpenny stamp to make it legal, and it must be stamped before being signed. Before signing a bill of lading the master should see that it agrees with the contents of his charter party, and also compare it with the chief mate's receipts. Generally a set of three bills of lading are signed, and the master keeps one copy for reference.

Demurrage.

If the ship is not discharged or loaded according to the lay days mentioned in the charter party, then demurrage is claimed daily, and the claim for Sunday is also made on Saturday. The daily amount for detention after the lay days are expired is specified in the charter party.

Despatch Money

Is the amount paid to the charterer by the shipowner for loading and despatching the vessel before the expiration of the lay days.

Dead Freight

Is freight claimed and paid to the shipowner for the balance of cargo required to complete loading, that is, when the amount of cargo shipped is less than the quantity stated in the charter party; then the shipowner is paid in the same way as if the cargo had been shipped.

Portage Bill.

A bill showing the exact amount of wages due to each member of the crew at the end of the voyage.

Disbursement Sheet.

A complete and detailed account of the expenditure during the voyage, also all the money received.

Invoice.

A detailed list of all the contents in each package of cargo, stating the prices, etc.

Manifest.

A cargo manifest is required for the Customs. It contains a list of all the cargo on board, stating the contents, marks and numbers of the various articles shipped. A separate manifest is also made, giving a detailed list of the stores on board. A passenger list is also made up giving full particulars of all on board. Also a crew list.

Jerquing Note.

A note received from the Custom House officer who has made the final inspection of all the cargo landed.

Jettison

Is the throwing overboard of cargo for the safety and preservation of the ship and crew. Flotsam is goods or cargo which are left floating on the sea when a vessel founders, or is wrecked.

Charter Party.

A charter party is a stamped agreement between the owner and merchant at home; abroad, between the master and merchant, by which the former lets, and the latter hires the vessel for one or more voyages, or time charter, or for a lump sum. Special forms of charter party are sometimes used for particular trades. Every charter party must state that the vessel is tight, staunch and strong, and in every respect seaworthy and fit for the intended voyage.

The principal clauses are:—The number of lay days, clearly stated whether "working" or "running" days, etc.; the amount of freight, when and how it is to be paid; despatch money,

demurrage, towing, etc., also penalty for non-performance, which is usually the estimated amount of freight. A charter party requires a sixpenny stamp to make it legal. Before signing a charter party obtain full particulars about the port, such as depth of water, so that the vessel will be afloat at all times during loading or discharging; also general despatch, expenses of the port, etc.

Consignee.

The person or firm to whom the cargo is consigned, *i.e.*, the party authorised to receive them.

Bill of Lading.

When the port of destination is reached the cargo is delivered to the party who holds the bill of lading, which must be indorsed by the shipper. The master should obtain and keep the indorsed bill of lading.

Barratry.

Fraud committed by the master, or any member of the crew, against the shipowner, insurers, etc.

Mortgage of a Vessel.

A bond or deed whereby a ship is pledged as security for money advanced to the owner.

Bill of Exchange.

A bill of exchange is a written order sent by one person to another, directing the latter to pay on account of the former, to some person (or firm), a certain sum of money on a certain date.

The bill may be payable on demand or at a certain number of days after sight. The bill must have a penny stamp. A bill of exchange which is payable on demand is promptly paid when presented.

Salvage

Is a claim or money paid for rendering assistance to a vessel in distress.

Negligence Clause.

By this clause the ship is freed from responsibility for "The Act of God"; the King's enemies; pirates; loss or damage from machinery, fire, etc.; or, any act, neglect, or default whatsoever of pilots, master or crew, in the management or navigation of the vessel; and other dangers and accidents of the seas, rivers, etc.

Assistance.

If you fall in with a vessel in fine weather wanting assistance, be sure to examine your charter and bill of lading to see if "leave to tow" is inserted, then ascertain the value of the ship and cargo and agree for towage to the nearest porton your course, making a reasonable bargain, and remember your ship is not a tug and you must be well paid for the towage, proper entries should be made in the log.

Saving Life.

Never refuse to "stand by" and always offer to save life, and to take the crew off.

Health.

Every sensible captain will be careful about the health of his crew, and see that the forecastles, houses, etc., are kept thoroughly clean and disinfected if necessary, also that the food is properly cooked and served.

Discipline.

Strict discipline should be kept. The captain and officers should maintain a correct bearing and language; if the men are properly treated there should be no occasion to "log." Inspection of crew and quarters should be held on Sunday morning, and when possible Divine Service should be conducted. A library should be on board all ships, with free access to the crew.

Lime-Juice.

The allowance is one ounce each man per day, to be served to the crew when they have been at sea ten days.

Scurvy.

To prevent scurvy the crew should have a liberal supply of fresh provisions and lime-juice. In the event of scurvy breaking out, I would give them a double allowance of lime-juice; also preserved vegetables, such as cabbage, onions, potatoes, etc. I would see that the crew and their quarters are kept thoroughly clean, and have the forecastle kept dry and well ventilated.

Pratique.

A certificate granted by the Customs officers, giving permission to enter port and have free communication with the shore.

Bill of Health.

The bill of health in a British port is granted by the Customs, and must be officially stamped or signed by the Consul of the country to which the vessel is bound. A British vessel when leaving a foreign port will receive the bill of health from the British Consul.

Disinfection.

Close and stop up every opening with waste or oakum, then fumigate by burning sulphur in saucers, or by placing carbolic acid in shallow vessels around the cabin; after this is done, scrub the place out and open all ports and doors for ventilation.

Duty of Master in Cases of General Average.

When a vessel is bound to a foreign port, particularly any Continental port, and there is any likelihood of a claim being made, either for general average, sacrifice or expenditure, it is specially incumbent on the master to see that the shipbroker at the port of destination takes immediately all the steps necessary to protect the shipowners' lien against the cargo for proportion of general average.

Should any of the necessary formalities be omitted, it is probable that the shipowners' lien for proportion of general average will be at least jeopardised, if not altogether defeated.

Place of Adjustment of General Average.

Under ordinary circumstances a general average statement should be made up at the port, or, at least, under the law and practice existing at the port of destination, except that where the York-Antwerp Rules are provided for in charter party and bill of lading, these rules must take the place of the law and practice at port of destination wherever there is any difference between such rules and the said law and practice.

General Average.

The whole principle of general average is that of the proportionate payment by the parties interested in the ship, freight and cargo, of either sacrifice or expenditure incurred at a time of peril for the general benefit.

The following list falls under general average:—

1.—Loss of Cargo and Freight and Damage to Cargo.

Loss of cargo and freight by jettison from under deck.

Loss of cargo and freight by jettison from the deck, when it can be shown that it is the invariable and well-known custom of the trade in which the vessel is at the time engaged to carry deck cargo.

Damage to cargo by water during jettison, or damage necessarily occasioned to cargo through jettison.

Damage done to packages of cargo, which have themselves not been on fire, by water or other means used to extinguish fire on board.

Loss of cargo and freight on cargo burnt as fuel for a steamer for general safety (where the original supply of coal on board the steamer was ample, with a fair margin, for the passage or part of passage on which the steamer was at the time engaged).

Loss of cargo and freight on cargo burnt for fuel for donkey engine for pumping (on same consideration as cargo burnt for fuel for steamer).

II.—Ships' Materials.

Masts, spars, sails, or rigging cut away for the common safety.

Chains and anchors slipped from.

Damage to sails set to force a stranded ship off the ground, or to force her further on the ground for better safety.

Damage to ropes, winches, windlasses, boats, etc., used in the endeavour to float a stranded ship.

Damage to a steamer's machinery incurred in the endeavour to float a stranded ship when in a position of peril.

Coals and engine stores used in this endeavour.

Damage done to a ship in the endeavour to extinguish a fire, or to facilitate jettison.

Also expenses, etc., incurred in floating a stranded vessel.

Average Bond.

A document signed by the consignees agreeing to pay the amount of general average.

Particular Average.

Particular average is damage or loss to either ship, cargo and freight, purely accidental in its nature, and not damage or expense voluntarily incurred for the benefit of all concerned. We give as example of this, the following cases of particular average on ship:—

Straining of a vessel at sea through bad weather.

Loss of masts or spars from the same cause.

Loss of sails burst or carried away by the sea, or by the loss of masts or spars.

Damage to the hull or machinery of a vessel through bad weather, fire, collision, stranding, or contact with piers and similar constructions.

Claims for particular average on cargo are entirely similar in their nature and principle to particular average on ships, that is, they must be accidental, and caused by one of the perils covered by the policies of insurance under which the cargo is covered. These terms are so numerous and so various in their stipulations that they cannot be dealt with in the space at disposal, but the following general rules may be safely followed out:—

1. The damage must be properly surveyed as soon as discovered at the port of destination.

2. Lloyd's Agent, or the Agent of the Insurance Company covering the goods, should be notified so that the Underwriters may be properly represented at the survey.

3. The surveyors' reports should state:—

(*a*) Cause and nature of the damage.

(*b*) Gross sound market value duty paid of the goods at port of destination, stating whether for cash or credit, and if the latter, rate of discount for cash and term of credit.

(*c*) Whether it is the practice at the port to deal with sound goods of a similar nature on duty paid or in bond terms, mentioning at the same time the amount of the duty and the rebate on same (if any).

(*d*) If the damaged goods are sold the gross proceeds should be mentioned, and, if not sold, the amount of the agreed depreciation should be stated.

(*e*) The charges incurred in survey and realisation should be mentioned, as also, when possible, what the ordinary charges would have been had the goods not arrived damaged.

Protest.

A protest is a declaration by the master, officers, and crew, or some of them, giving particulars of the voyage, of any bad weather or accident encountered, and of the course which, under any circumstances of emergency, the master has thought proper to pursue. It is made before a Notary Public or Consul whenever possible; or, if neither be within reach, then before a magistrate or other local authority. In all cases of putting into an intermediate port,

or in which either ship or cargo has received damage from any cause, the circumstances should be the subject of a protest made as soon as possible after arrival in port, while the facts are fresh in the declarants' minds; it should contain a full narrative and be carefully prepared, being, as it is, of great importance in connection with any claims which may arise under insurances, and in the adjustment of any averages.

Protests may also be made by the master against the charterers of the ship, or against the consignees of goods, for not loading or unloading in accordance with contract or in stipulated time, and by the merchant against the master for misconduct, delay in sailing, not signing bills of lading in customary form, and other irregularities.

Credit is usually given by the merchants and underwriters to the contents of a protest when free from all circumstances of suspicion, and in most foreign countries the noting or extending of a protest within a certain limit of time after arrival in port is essential to the validity of any claim which may have to be made against any other vessel or other persons there.

Average Guarantee.

Money deposited in the bank, or to Lloyd's, covering the probable amount due to general average.

Average Adjuster.

The average adjuster is generally appointed by the owner. He is an expert at that particular business, viz., making up statements of general average, showing the amounts due, or payable by each party.

Freight Clause

Is simply a clause stating the amount of freight, and when and how it is to be paid.

Floating Clause.

A clause stating that the vessel must be afloat at all times and tides at the port of destination, otherwise the cargo will be discharged as near the port as possible; other clauses may be inserted in the charter party, such as towing clause, deviation from the voyage, etc.

Primage.

A percentage over and above the freight paid by the charterer.

Boat Drill and Inspection as to Life-Saving Appliances.

The master of every British ship shall enter, or cause to be entered in the official log-book, a statement of every occasion on which boat drill is practised on board the ship, and on which the life-saving appliances on board the ship have been examined for the purpose of seeing that those appliances are fit and ready for use.

If the master of the ship fails to comply with any requirement of this section of the Merchant Shipping Act, 1906, he shall be liable on summary conviction, for each offence, to a fine not exceeding £10.

Passengers.

Passengers are not to be carried on more than one deck below the water-line—Penalty £500.

Return as to Passengers.

The master of every ship, whether a British ship or a foreign ship, which carries any passenger to a place in the United Kingdom, shall make proper returns, and the passenger shall furnish the master of the ship with any information required by him for the purpose of the return. For any false return or false information the master or passenger shall be liable for each offence to a fine not exceeding £20.

Cattlemen.

If the master fails to make the return, or makes a false return, he is liable to a fine not exceeding £100.

Emigrant Ship.

The master must post up the food scale in the 'tween decks. For non-performance the penalty is £2 per day.

If a steerage passenger requests to see the food scale, the master must produce it under penalty of £2.

Entering a Foreign Port.

On arrival at a foreign port, get pratique as soon as possible, then report the vessel to the port authorities. Also send notice of arrival to your merchant.

To enter the ship you require the bill of health, manifest and store list. Also deposit your Articles with the British Consul. If you expect damage to the cargo through stress of weather, note a protest. Collect the freight according to charter party, and remit to your owners.

Deck Cargoes.

There are classes of ships approved for the purpose by the Board of Trade for carrying heavy wood goods as deck cargo.

The Regulations are under Section 10* of Merchant Shipping Act, 1906.

DATES OF SUMMER AND WINTER FREEBOARDS.

Winter freeboards apply to vessels sailing from European and Mediterranean ports from October to March inclusive, and summer freeboards to the remaining six months, that is, April to September inclusive. In other parts of the world, the summer freeboards should be used during the corresponding or recognised summer months.

Indian Summer Freeboard.

The freeboard for Indian summer applies to voyages in the fine season in the Indian seas between the limits of Suez and Singapore.

* "The Merchant Shipping Act, 1906," Brown, Son & Ferguson, Ltd., Glasgow.

Wreck.

Any wreck found inside the United Kingdom, or found outside the United Kingdom and brought inside the United Kingdom, must be delivered to the receiver of wrecks, under a penalty of £100, and double value of wreck.

Derelict.

An abandoned vessel, or anything thrown away or abandoned by the owner.

Salvage.

A recompense allowed by law for the saving of a ship or goods from loss at sea.

Constructive Total Loss.

When a vessel is stranded and so badly damaged that the cost of repairing her would exceed her value when repaired.

If abroad or at home call a survey and get certificates to that effect. It must be clearly proved that the vessel is really a constructive total loss, before the owner can claim insurance or total loss.

DELIVERY OF OFFICIAL LOG FOR BOTH HOME AND FOREIGN TRADE.

The master of every foreign-going ship shall within forty-eight hours after the ship's arrival at her final port of destination in the United Kingdom, or upon the discharge of the crew, whichever first happens, deliver the official log book of the voyage to the superintendent before whom the crew is discharged.

The master or owner of every home-trade ship for which an official log is required to be kept shall, within twenty-one days of the thirtieth day of June and the thirty-first day of December in every year, transmit or deliver the official log book for the preceding half-year to some superintendent in the United Kingdom.

The master of every British sea-going ship shall, upon her leaving any dock, wharf, port, or harbour for the purpose of proceeding to sea, record her draught of water and the extent of her clear side in the official log book (if any), and shall produce the record to any chief officer of Customs whenever required by him, and if he fails without reasonable cause to produce the record, shall for each offence be liable to a fine not exceeding twenty pounds.

If an official log book is not kept in the manner required by this Act, or if an entry directed by this Act to be made therein is not made at the time and in the manner directed by this Act, the master shall for each offence be liable to the specific fine in this Act mentioned in respect thereof, or, where there is no such specific fine, to a fine not exceeding five pounds.

If any person makes, or procures to be made, or assists in making, an entry in the official log book in respect of any occurrence happening previously to the arrival of the ship at her final port of discharge more than twenty-four hours after that arrival, he shall for each offence be liable to a fine not exceeding thirty pounds.

If any person wilfully destroys or mutilates, or renders illegible any entry in an official log book, or wilfully makes or procures to be made, or assists in making a false or fraudulent entry in or omission from an official log book, he shall in respect of each offence be guilty of a misdemeanour.

Masters should read up York-Antwerp Rules, which are generally used for settling General Average claims, but they are only applicable when the clause has been inserted in the "Charter party" and "Bills of lading." Otherwise General Average will be settled in accordance with British law, and usages of the Port.

COLLISIONS WITH LIGHT-VESSELS.

Caution.—In consequence of light-vessels being from time to time run into and seriously damaged by vessels navigating in their vicinity, the Corporation of Trinity House deem it desirable to warn mariners that when passing a light-vessel, and particularly when attempting to cross her bows, they should make due allowance for the set of the tide, and take every other precaution desirable in the circumstances in order to avoid striking the light-vessel. Attention is specially directed to the 666th section of the Merchant Shipping Act, 1894, which provides that anybody wilfully or negligently running foul of any light-vessel or buoy shall, in addition to the expense of making good any damage so occasioned, incur a penalty of £50.

OBSERVANCE OF COLLISION REGULATIONS AND DUTY OF MASTERS IN CASES OF COLLISION.

Merchant Shipping Act, 1894.

The following Sections, 419 and 422, of the Merchant Shipping Act, 1894 (formerly Sections 16 and 17 of the Merchant Shipping Act, 1873), provide that :—

"419.—(1) All owners and masters of ships shall obey the Collision Regulations, and shall not carry or exhibit any other

lights, or use any other fog signals, than such as are required by those Regulations.

" (2) If an infringement of the Collision Regulations is caused by the wilful default of the master or owner of the ship, that master or owner shall, in respect of each offence, be guilty of a misdemeanour.

" (3) If any damage to person or property arises from the non-observance by any ship of any of the Collision Regulations, the damage shall be deemed to have been occasioned by the wilful default of the person in charge of the deck of the ship at the time, unless it is shown to the satisfaction of the Court that the circumstances of the case made a departure from the Regulation necessary.

"(4) Where in a case of collision it is proved to the Court before whom the case is tried, that any of the Collision Regulations have been infringed, the ship by which the Regulation has been infringed shall be deemed to be in fault, unless it is shown to the satisfaction of the Court that the circumstances of the case made departure from the Regulation necessary.

"(5) The Board of Trade shall furnish a copy of the Collision Regulations to any master or owner of a ship who applies for it.

"422.—(1) In every case of collision between two vessels, it shall be the duty of the master or person in charge of each vessel, if and so far as he can do so without danger to his own vessel, crew and passengers (if any)—

(*a*) To render to the other vessel, her master, crew and passengers (if any) such assistance as may be practicable, and may be necessary to save them from any danger caused by the collision, and to stay by the other vessel until he has ascertained that she has no need of further assistance, and also

(*b*) To give to the master or person in charge of the other vessel the name of his own vessel and of the port to which she belongs, and also the names of the ports from which she comes and to which she is bound.

"(2) If the master or person in charge of a vessel fails to comply with this section, and no reasonable cause for such failure is shown, the collision shall, in the absence of proof to the contrary, be deemed to have been caused by his wrongful act, neglect, or default.

"(3) If the master or person in charge fails without reasonable cause to comply with this section, he shall be guilty of a misdemeanour, and, if he is a certificated officer, an inquiry into his conduct may be held, and his certificate cancelled or suspended."

DERELICT VESSELS (REPORT) ACT, 1896.

An Act for the better reporting of floating derelicts. (2nd July, 1896.)

1. This Act may be cited as the Derelict Vessels (Report) Act, 1896.

2. Every master or other person for the time being in command of any British ship, after the passing of this Act, who shall become aware of the existence on the high seas of any floating derelict vessel, shall notify the same to the Lloyd's agent at his next place of call or arrival, and shall, together with such notification, furnish to the Lloyd's agent all such information as he may possess as to the supposed locality or identity of such derelict vessel, and the date when and place where the same may have been observed by or reported to him, and the Lloyd's agent shall forthwith, on receipt of such notification and information, transmit the same to the Secretary of Lloyd's in London.

And if any such master fails to make such a report he shall be liable, on summary conviction, to a penalty not exceeding £5.

3. If there shall be no Lloyd's agent at the next place of call or arrival, then, and in such case the notification shall be made and

the information furnished by such master or other person as aforesaid, to the Secretary of Lloyd's, London.

Any information received by the Society of Lloyd's as aforesaid, in pursuance of this Act, shall be published by the Society forthwith in the same manner and to the same extent as its reports of shipping casualties, and the Society shall also forthwith communicate such information to the Board of Trade.

SINGLE SHIPS APPROACHING SQUADRONS.

The attention of shipowners and masters is called to the danger to all concerned which is caused by single vessels approaching a squadron of warships so closely as to involve risk of collision, or attempting to pass ahead of, or through, or to break the line of, such squadrons. The Board of Trade find it necessary to warn mariners that on such occasions it would be in the interests of safety for single ships to adopt timely measures to keep out of the way of and avoid passing through a squadron.

GENERAL SUGGESTIONS FOR FIRE EXTINCTION.

Good strong hose pipes should be provided, and there should be a forceful and abundant supply of water. In all ordinary cases water is the most efficient medium for extinguishing fires.

The ship should be regularly patrolled. The first knowledge of fire is often obtained by smell. The ventilators and other openings to the holds and store rooms should be regularly visited for the purpose of ascertaining, either by sense of smell or observation of smoke, whether everything is right or not. A fire, which in its initial stage might be quite easy to extinguish, may, if allowed to develop, rapidly become of such a fierceness and size as to be beyond control.

If an outbreak of fire cannot be located, or a hose cannot be brought to bear directly upon it, it is well to bear in mind that fire cannot burn without air, and endeavours should be made as far as possible to prevent air reaching the fire and feeding it. Ventilators, sounding pipes and other openings should be closed.

Fire Detection and Extinction.

1. An efficient patrol system shall be maintained, so that any outbreak of fire may be promptly detected. In addition, a fire alarm or fire detecting system shall be provided, which will automatically indicate or register at one or more points or stations, where it can be most quickly observed by officers and crew, the presence or indication of fire in any part of the ship not accessible to the patrol system.

2. Every ship shall be provided with powerful pumps, operated by steam or other means. On ships of less than 4000 tons gross there shall be two, and on larger ships three of these pumps. Each of the pumps shall be capable of delivering a sufficient quantity of water in two powerful jets simultaneously in any given part of the ship, and shall be available for immediate use before the ship leaves port.

3. The service pipes shall permit of two powerful jets of water being simultaneously directed on any given part of a deck occupied by passengers and crew, when the watertight and fire-resisting doors are closed. The service pipes and hoses shall be of ample size and made of suitable material. The branches of the pipes shall be so placed on each deck that the fire hose can be easily coupled to them.

4. Provision shall be made whereby at least two powerful jets of water can be rapidly and simultaneously directed into any space containing cargo. In addition, arrangements shall be made whereby smothering gas sufficient to give a minimum volume of free gas equal to 30 per cent. of the gross volume of the largest hold in the ship can be promptly conveyed by a permanent piping system into each compartment in which cargo is carried. Steam in adequately equivalent proportion may be accepted in place of smothering gas on steam-driven ships. Provision for the supply of smothering gas or steam need not be required in ships of less than 1000 tons gross.

5. A sufficient number of portable fluid fire extinguishers shall be provided, at least two being carried in each machinery space.

6. Two equipments, consisting of a smoke helmet or breathing apparatus and a safety lamp, shall be carried on board, and kept in two widely separated places.

7. In steamships in which the main boilers are oil fired, there shall be provided, in addition to means whereby two powerful jets of water may be rapidly and simultaneously directed into any part of the machinery spaces—

(*a*) Suitable conductors for spraying water on oil without undue disturbance of the surface.

(*b*) In each firing space, a receptacle containing 283 cubic decimetres (10 cubic feet) of sand, sawdust impregnated with soda, or other approved dry materials, and scoops for distributing the same.

(*c*) In each boiler room, and in each of the machinery spaces in which a part of the oil fuel installation is situated, two approved portable extinguishers of a type discharging froth or other approved medium suitable for quenching oil fires.

(*d*) Means whereby froth may be rapidly discharged and distributed over the whole of the lower part of the boiler room or of any one boiler room, if there are more than one, or of any machinery space in which oil fuel units or settling tanks are situated. The quantity of froth which can be discharged shall be ample to cover to a depth of 15·24 centimetres (6 inches) the whole area of the plating formed in any one compartment by the inner bottom plating, or by the shell plating of the vessel, if there is no double-bottom tank. If the engine and boiler rooms are not entirely separate, and fuel can drain from the boiler room bilges into the engine room, the combined engine and boiler rooms shall be considered as one compartment. The apparatus shall be operated and controlled from outside the compartment in which the fire may occur.

(*e*) In addition to the foregoing, one extinguisher of the froth type of at least 136 litres (30 gallons) capacity in steamships having one boiler room and two such extinguishers in steamships with more than one boiler room. These extinguishers shall be provided with hoses on reels suitable for reaching any part of the boiler rooms and spaces containing oil-fuel pumping units. Equally efficient apparatus may be accepted in place of the 136 litres (30-gallons) extinguishers.

(*f*) All containers and valves by which they are operated shall be easily accessible and so placed that they will not readily be cut off from use by an outbreak of fire.

(8) In vessels propelled by internal combustion engines there shall be provided in each of the machinery spaces, in addition to

means whereby two powerful jets of water may be rapidly and simultaneously directed into any part of the machinery spaces, together with suitable spraying conductors, froth extinguishers as follows:—

(*a*) At least one approved 45 litres (10-gallons) extinguisher with an addition of one approved 9 litres (2-gallons) extinguisher for each 1000 B.H.P. of the engines, but the total number of 9 litres (2-gallons) extinguishers so supplied shall be not less than two and need not exceed six.

(*b*) When a donkey boiler is situated in the machinery space there shall be provided, in place of the 45 litres (10-gallons) extinguisher mentioned above, one of 136 litres (30-gallons) capacity, fitted with suitable hose attachments or other approved methods for distributing the froth.

(9) In steamships using oil fuel, if the engine and boiler rooms are not entirely separated by a steel bulkhead, and if fuel oil can drain from the boiler-room bilges into the engine room, one of the fire pumps shall be situated in the tunnel or other space outside the machinery compartment. When more than two pumps are required they shall not all be fitted in the same space.

(10) Where any special type of appliance, extinguishing medium or arrangement is specified, any other type of appliance, etc., may be allowed, provided that it is not less effective than the specified one. For example, a carbon dioxide system may be accepted in place of a froth installation (paragraph (7), sub-paragraphs (*d*) and (*e*)), provided that the quantity of carbon dioxide carried is sufficient to give a gas saturation of about 25 per cent. for the gross volume of the stokehold to about the top of the boilers.

(11) All the fire-extinguishing appliances shall be thoroughly examined at least once each year by a surveyor appointed by the Administration.

Fire-resisting Bulkheads.

Ships shall be fitted above the bulkhead deck with fire-resisting bulkheads which shall be continuous from side to side of the ship and arranged to the satisfaction of the Administration.

They shall be constructed of metal or other fire-resisting material, effective to prevent for one hour, under the conditions for which the bulkheads are to be fitted in the ship, the spread of fire generating a temperature of 1500° F. (815° C.) at the bulkhead.

Steps and recesses and the means for closing all openings in these bulkheads shall be fire-resisting and flame-tight.

The mean distance between any two adjacent fire-resisting bulkheads in any superstructure shall in general not exceed 131 feet (40 metres).

Muster List.

The muster list shall assign duties to the different members of the crew in connection with—

(*a*) The closing of the watertight doors, valves, etc.

(*b*) The equipment of the boats, life-rafts and buoyant apparatus generally.

(*c*) The launching of the boats attached to davits.

(*d*) The general preparation of the other boats, the life-rafts and buoyant apparatus.

(*e*) The muster of the passengers.

(*f*) The extinction of fire.

The muster list shall assign to the members of the stewards' department their several duties in relation to the passengers at a time of emergency. These duties shall include:—

(*a*) Warning the passengers.

(*b*) Seeing that they are dressed and have put on their life-jackets in a proper manner.

(*c*) Assembling the passengers at muster stations.

(*d*) Keeping order in the passages and on the stairways, and, generally, controlling the movements of the passengers.

The muster list shall specify definite signals for calling all the crew to their boat and fire stations, and shall give full particulars of these signals.

Fire Drill.

Fire drill shall be observed at least once a month in all foreign-going cargo vessels. The great utility of woollen or asbestos blankets for smothering small fires should always be borne in mind at fire drills.

Annual Inspection.

The fire extinguishing appliances shall be thoroughly examined by an approved surveyor at least once every 12 months.

At these inspections *all* the fire hoses, both working and spare, shall be tested under working conditions, and any defects which may be discovered shall be made good to the surveyor's satisfaction.

A fair proportion of the chemical fire extinguishers shall likewise be tested (if possible in the presence of the men likely to use them in case of emergency), and afterwards recharged, or if considered to be defective, replaced by new ones. Before testing a chemical fire extinguisher the surveyor shall carefully examine the apparatus and satisfy himself as to its sufficiency for the pressure which it may have to sustain, and for this purpose the charge shall be withdrawn.

SHIPS, BOATS AND LIFE-SAVING APPLIANCES.

Attention is called to the fact that the boats, lifebuoys, life-jackets, and other life-saving appliances on board all ships must be kept so as to be at all times fit and ready for use, and that a heavy penalty is incurred under Section 430 of the Merchant Shipping Act, 1894, when this is not done. At all times it is

particularly important that ships' boats should be able to be promptly and safely lowered into the water.

To ensure this it is necessary that the boats should be regularly swung out, put into the water and exercised, that the plugs should be securely attached in the boats, and the falls should be stowed so as to be immediately available for use. Life-jackets and lifebuoys should be frequently examined.

In accordance with Section 9 of the Merchant Shipping Act, 1906, a record must be kept in the official log-book of every occasion on which boat drill is practised and the life-saving appliances are examined, each entry being made as soon as possible after the drill or inspection to which it relates. Any person who wilfully makes a false or fraudulent entry in an official log-book is liable on summary conviction to a penalty not exceeding £100.

The General Emergency Signal.

The general emergency signal shall be a succession of more than *six short blasts* followed by *one long blast* on the whistle or siren.

Emergency practices should, as a general rule, be held fortnightly and should include:—

(1) Fire drill.

(2) Drill in closing of watertight doors, side scuttles and all openings in the ship's sides.

(3) Boat drill.

COAL CONSUMPTION.

RULE.—In the event of running short of coals, the main point to remember is that the coal consumption varies with the cube of the speed.

The cube of a number is the product obtained by multiplying it by itself twice in succession.

Thus the cube of 4 is $(4\times4\times4=64)$.

The following worked examples will fully explain how to find the most economical speed for high powered boats and ordinary cargo steamers.

WORKED EXAMPLE.—If 2·2 tons per hour be required for a speed of 20 knots in fine weather, how much is required for a speed of 15 knots under the same conditions?

Knots		Knots		Tons
20^3	:	15^3	::	2·2

20
400
20
8000

15
75
15
225
15
1125
225
3375
2·2
6750
6750

8000)74250(0·928 ton *Ans.*
72000
22500
16000
65000
64000

Ans. Speed reduced to 15 knots, the consumption has been lowered from 2·2 tons to 0·928 ton per hour.

The knowledge of coal consumption is valuable when a vessel is likely to run short of fuel.

When the speed of a vessel exceeds 15 knots, the proportion of coal consumed in relation to speed is very great, as shown in the foregoing example.

Of course, the foregoing rule applies only to ordinary fine weather, with a smooth sea.

WORKED EXAMPLE.

If a steamer requires 1·25 tons of coal to obtain a speed of 12 knots in fine weather, what will her consumption be under the same conditions at a reduced speed of 8 knots?

Then as 12^3 is to 8^3, so is 1·25 to the required quantity.

Knots		Knots		Tons
12^3	:	8^3	::	1·25

1728
512
×1·25

2560
1024
512

÷1728)640·00(0·37 ton *Ans.*
5184×

12160
12096

64

Ans. At reduced speed the consumption falls to 0·37 ton per hour.

Examples for Practice.

If a steamer consumes 12 cwts. of coal per hour at a speed of 11 knots, what will her consumption be under the same conditions when her speed is reduced to 8 knots?

Ans. 4 cwts. 2 qrs. 13 lbs.

If a steam vessel carrying 8000 tons of cargo consumes 30 tons of coal per day at a speed of 240 miles per day, what will her consumption be at a reduced speed of 144 miles per day, under the same conditions?

Ans. 6 tons 9 cwts. 2 qrs. 11 lbs.

For moderate speeds the consumption of coal varies approximately as the speed squared, multiplied by the distance.

It may be that, through bad weather, or other causes, a vessel is found to be getting short of coal, in which case, speed must be reduced to economise the consumption of the remaining coal so that she may reach port.

Example.—A vessel is 960 miles from her destination and has sufficient coal to steam 700 miles at 10 knots. At what speed must she steam to reach her port?

Rule.—The distance to go under the new consumption is to the distance it is possible to go under the old consumption, as the original speed squared is to the square of the required speed.

$$960 : 700 :: 10^2 : x^2$$

$$\frac{\overset{175}{\cancel{700}}\times\overset{5}{\cancel{10}}\times\cancel{10}}{\underset{\underset{12}{\cancel{24}}}{\cancel{960}}} = \frac{875}{12} = 12)875 \quad 72{\cdot}92$$

knots

8)72·92)8·5 about.
64
—
165) 892
825

Or worked by logs.

	700 log	2·845098
10^2=	100 log	2·000000
		4·845098
	960 log	2·982271
		2)1·862827
		0·931413=8·539 knots.

Example.—A vessel's usual speed is 12 knots on a coal consumption of 30 tons per day. She has 100 tons of coal left in the bunkers and her distance from port is 1440 miles. Required the reduced speed at which to steam to reach her destination.

There is 100 tons, at 30 tons per day we have $3\frac{1}{3}$ days coal.

In $3\frac{1}{3}$ days at 12 knots we could steam.

$$24\times\overset{4}{\cancel{12}}\times\frac{10}{\cancel{3}} = 960 \text{ miies}$$

$$\text{so } 1440 : 960 :: 12^2 : x^2$$

$$\frac{96\cancel{0}\times\cancel{12}\times\cancel{12}}{\underset{\cancel{12}}{\cancel{1440}}} = 96 \qquad \therefore x^2 = 96$$

$$\therefore x = \sqrt{96}$$

Required speed 9·8 knots.

9)96(9·8 knots
81
—
188)1500
1504

By logs

	960 log	2·982271
12^2=	144 log	2·158362
		5·140633
	1440 log	3·158362
		2)1·982271
		0·991136=9·798 knots.

TIDES.

(1) Tides are caused by the attraction of the sun and moon, of course, the influence of the moon is greater than that of the sun because it is nearer to the earth.

(2) Spring Tides occur at near new moon and again at full moon. They are caused by the positions of both sun and moon; when their combined effect is greatest, the result is spring tides which we have at intervals of about 14 days, this being the time elapsed between full and change.

(3) Neap Tides—When the sun and moon are at right angles to each other as viewed from the earth, the result is the effect that the high water due to the attraction of the moon is diminished and produces neap tides.

(4) The height of a tide is its height at high water above the level of mean low water springs, *i.e.*, the level for which soundings on charts are given.

(5) The range of a tide on any day is the difference between high and low water on that day.

(6) The time of high water at any place on the day of new or full moon is commonly called the establishment of the place, or port. It is printed on charts in Roman letters.

(7) We must take care not to confound the time of the *turn of the tide stream* with the time of high water. Mistakes and errors have often been produced in tide observations by supposing that the turn of the tide stream is the time of high water. But this is not so. The turn of the stream generally takes place at a different time from high water, except at the head of a bay or creek. The stream of flood commonly runs for some time, often for hours, after the time of high water. In the same way, the stream of ebb runs for some time after low water.

Remarks on the Progress of the Tide Wave.

The general progress of the tide wave along even the most frequented shores is still imperfectly known; and, about the

connection of the tides over the general areas of large oceans we are as yet entirely in the dark; there is therefore an ample field of important and useful discovery in this subject, even by means of brief and scattered series of observations; still more is this the case if simultaneous or connected observations can be made.

The main general features of the progress of the tides, as hitherto ascertained, are the following:—

The tide wave which brings the tides to the coasts of Europe comes from the Atlantic, and brings high water to the western coast of Spain and Portugal about 2 hours after the moon's transit; to the western coast of France about 3 hours; to the western coast of Ireland and to the Land's End about 4 hours. The tide wave then runs along the south coast of England, and the north coast of France, to the Strait of Dover, which it reaches about 11 hours after the moon's transit. It also runs along the west coast of Ireland and Scotland, and reaches the Orkneys about 9 hours after the moon's transit. From thence it enters the North Sea, and runs along the east coast of Britain, so as to reach Peterhead about 12 hours after the moon's transit, and Harwich in about 12 hours more, where it meets the tide wave which had come through the Strait of Dover derived from the same Atlantic wave about 12 hours earlier. The tides of the North Sea are produced by the mixture of these two tide waves, and hence follow complicated laws: as for the same reason do those of the Irish Channel.

The tide wave which brings the tides to the eastern coast of North America appears to reach the southern parts about 7 hours, and the northern parts of the United States about 11 hours, after the moon's transit; but its course has not yet been distinctly traced.

How the tides on the eastern and on the western shores of the Atlantic are connected has not yet been clearly shown. It is difficult to explain the tides of the Atlantic Islands (Madeira, Teneriffe, &c.) by the simple form of a tide wave.

It is remarkable that the European tide wave, though following

the moon's transit at a definite interval (nearly), moves (at first) in a direction opposite to the moon—namely, from west to east.

If we go to the Pacific we find the same phenomenon. The tides on the western shore of South America, near Cape Horn, also move from west to east. They are simultaneous with the moon's transit at Chiloe; 1 hour after at Cape Pillar; and at Cape Horn it is 3½ hours later than this.

Along a large portion of the east shore of the Pacific it seems difficult to say whether the tide wave travels northward or southward. From the Isthmus of Panama, however, it appears plainly to travel to the northward, occupying about 9 hours to run from Realejo to Nootka Sound.

In the western parts of the Pacific the tide wave runs to the westward, as we learn by its progress along the coasts of New Zealand and Australia, where the movement is better known than on any coasts out of Europe. It visits New Zealand about 6 hours, and Australia about 10 hours, after the moon's transit *at Greenwich*.

In the central parts of the Pacific the tides are small and anomalous (for they do not clearly depend on the moon), and hence it is still more difficult to connect the *littoral* tides than in the Atlantic Ocean.

The outer regions of the Pacific, broken by large islands, and the Indian Ocean, have tides, of which the laws of progress are more complex, and have not yet been disentangled.

The Diurnal Inequality adds to the complexity of the tides. This inequality appears very conspicuously in the tides on the west coasts of Europe and the east coasts of North America; but its maximum in those two regions does not appear to be simultaneous. It is very large in the Indian Ocean and on the coast of Australia, having different phenomena at different places.

The movement of the tide along the surface of the ocean may be in some measure represented in the following manner:—Draw lines through all the places where it is high water at the same time; that is, one line (generally it will be a curved line)

through all the places where it is high water at *One* o'clock: another line through all the places where it is high water at *Two* o'clock; and so on. These lines, being the lines at which the tide is contemporaneous, are called *cotidal* lines. They represent the form of the *tide wave* which carries the tide from one point of the shore to another.

Such cotidal lines have been drawn in the "Phil. Trans." for 1833 and 1836, by Dr. Whewell, for those shores on which the tides are best known, and especially for the *coasts* of Europe.

But it appears that we cannot, by means of such cotidal lines, express the movement of the tides in oceanic spaces. The cotidal lines can only be drawn in the neighbourhood of *coasts*. ("Phil. Trans." 1848. Part I.)

*** The best way to disentangle the phenomena of the tides when we are observing them at any place is to refer the time of high water and low water to the time of moon's transit; and to do this *at once*, while the series of observations are going on. For want of following this rule, it has very often happened that long series of tide observations have been made which could not be turned to any use afterwards; and in almost every case the usefulness of such observations is by this method much increased, and the labour much diminished.

For further information on tides, *see Admiralty Tide Tables, or Brown's Tidal Streams*, price 6/6, published by Messrs. Brown, Son & Ferguson, Ltd., Glasgow, S. 1.

OCEAN PASSAGE.

Masters may have to write an essay on ocean passages. The candidate should know all the ocean passages, with winds and currents.

London to Calcutta is frequently given at the Board of Trade examinations:—Work down channel and make due allowance for tides (*see* Tide Tables, etc.). When crossing the Bay of Biscay allow for the Rennel Current and give Cape Finisterre a wide berth; then down the coasts of Spain and Portugal, keeping outside the Burlings, through the Straits of Gibraltar, being on your guard against currents which frequently set to the eastward. Also give Cabeza Shoals a wide berth; they bear N.W. by W. magnetic from Tarifa Point (*see* book of directions).

Two winds prevail in the straits, viz., easterly, called the Levante, and westerly, the Poniente.

Next set a course to pass Cape de Gata, then along the African coast, making due allowance for a S.W. set off the Island of Galeta, then pass Cape Bon, through the Malta Channel, and on to Port Said.

After coaling, etc., proceed through the canal. Exchange pilots at Ismailia, then on to Suez.

The Canal is about 87 miles long, 28 feet deep; it is being made deeper. After discharging the pilot, steam down the Gulf of Suez, keeping on the west side, which is free-est from dangers (*see* book of directions), then through the Red Sea, giving all dangers a wide berth and guarding against cross currents. Then navigate the Gulf of Aden, passing north of the Island of Sokotra in the S.W. monsoon and to the southward during the N.E. monsoons, next across the Indian Ocean (where surface currents may be expected), passing through the 8° channel to Colombo. After coaling, etc., proceed up the Bay of Bengal and get the pilot off Sand Heads, then up the River Hoogli to Calcutta.

Note.—In the Bay of Bengal cyclones may be expected during the change of the monsoons, viz., April, May, October and November.

Note.—Masters are held responsible even with a pilot on board, hence the necessity of always being on the alert.

ESSAY ON THE LAW OF STORMS.

Although much has been written about cyclones, there are still many points to unravel. The laws which we already know by observation and experience are of vital importance to the navigator. The system of winds which circulate is divided into two classes, viz.:—Cyclonic (those which revolve round areas of low pressure) and anti-cyclonic (which revolve around areas of high pressure). Anti-cyclones are of slow bodily movements, and generally bring moderate fine weather. Cyclones move more rapidly than anti-cyclones, having an onward and circular motion; and, while thus revolving, the storm is carried bodily to the westward, in low latitudes, northerly in North Latitude, and southerly in South Latitude, after which it recurves to the eastward.

The direction of the wind revolution in a cyclone in North Latitude is *against* the hands of a watch, in South Latitude *with* the hands of a watch. As the storm advances, it is deflected more and more from the equator in both hemispheres. In the Indian Ocean these storms appear to form in about 10° S., whence they proceed W.S.W. to about 30° S., afterwards taking a more southerly course near the island of Mauritius, and curving to about E.S.E. The indications of an approaching cyclone are a heavy, long swell with dense cloud banks of a dark or leaden appearance, occasionally a rumbling noise in the air with an unusual glare in the light, and a falling barometer; also a veering wind, or the wind suddenly shifting to the opposite point, accompanied with heavy falls of rain, and a general ugly appearance of the weather. On the approach of a cyclone it is advisable to heave to and ascertain how the centre bears; also to find out which semicircle the vessel is in so that the ship can be hove to on the coming up tack, and consequently avoid being caught aback.

This can be done by the following rules:—

(1) The centre of the storm bears about 12 to 8 points to the right of the wind in the Northern Hemisphere; and to the left in the Southern Hemisphere. When the barometer falls about

three-tenths allow 10 points, when it falls about six-tenths allow 8 points.

(2) If the wind change to the right in either hemisphere, the ship will be in the right-hand semicircle, therefore heave to on the starboard tack. If the wind change to the left, the vessel will be in the left-hand semicircle, heave to on the port tack.

Note.—If a vessel is sailing faster than the storm in the same direction, the wind would haul to the left in the right-hand semicircle, and to the right in the left-hand semicircle.

(3) If the vessel was on the line of progression the weather would continue to get worse, the wind increasing in violence but never changing, with a high sea and falling barometer. It is now advisable to run, bearing in mind that the main object for the safety of the ship is to avoid the vortex, where the sea is terribly confused and dangerous, and where a sudden and violent change of wind may occur from an unexpected quarter.

In the Bay of Bengal cyclones generally travel about N.W., and may be expected during the change of the monsoon, viz.:—April-May, or October-November, the latter months being the worst. In the North Atlantic they may be expected from July to November; they frequently travel W.N.W., recurving through north to an easterly direction.

These storms vary much in their onward motion according to the seas in which they occur; it is the rotary motion which gives them such great destructive power. On the approach of a cyclone make the vessel snug, and heave to on the coming up tack.

North Atlantic.—They frequently commence a few degrees north of the equator, sometimes in the vicinity of the Cape de Verde Islands, and generally travel W.N.W. to about the West India Islands, where they recurve to north and N.E., and may be expected from July to November.

Bay of Bengal and Arabian Sea.—Generally at the change of the monsoons, so that the periods of maximum frequency are approximately May and June together with October and November.

China and Japan Seas.—May occur in any month, but

principally between May and November, inclusive. In the lower latitudes they travel westward. Some pass over the mainland, some recurve to north and east, and eventually reach the West Coast of North America *via* Japan. Tracks of tropical storms of the North Pacific are similar to those of the North Atlantic.

Indian Ocean.—They commence about 10° south of the equator, and travel W.S.W. to the southward of the Mauritius, where they recurve to S.W., south, and S.E., and may be expected from November to May.

Australian Coast.—Travel to the S.W., southerly, and may be expected from December to March.

North Pacific.—Generally commence a few degrees north of the equator and travel W.N.W., recurving to N. and N.E., and may be expected from May to November.

South Pacific.—Frequently begin about 10° south of the equator and travel W.S.W., recurving to S.W. and S.E., and may be expected from December to April.

ESSAY ON GREAT CIRCLE SAILING.

In these days of high speed and keen competition the successful navigator who desires to make a rapid passage should be well posted up in the higher grades of navigation, especially in Great Circle Sailing. Great Circles are circles whose plane passes through the centre of the earth, and consequently divides it into two equal halves. The shortest distance between any two places is an arc of a great circle; the meridians, also the equator, are great circles, and in cases where the rhumb line coincides with any of these, that is due north or south, east or west on the equator, these are all great circles, and every knot the vessel sails is actually made good towards the port she is heading for. The track on the great circle and that on the rhumb line differ most widely from each other in high latitudes and between places on nearly the same parallels. In low latitudes where the places are situated north and south of the equator, and in all latitudes where the course is nearly on a meridian the two courses (that is the

Great Circle Course and the Rhumb Course) nearly coincide, and the difference between them is not so conspicuous.

How to find the Great Circle.—The Great Circle passing through two places may be found on a globe by stretching a thread evenly between them, or by turning the globe about till the two places fall on the upper edge of the wooden rim, or horizon, which thus marks the circle. The distance between the two places are measured along the equator of the globe, allowing 60 miles to a degree. The positions may now be taken from the globe, say, every 500 miles, and laid down on a Mercator's chart, thus showing the track of the Great Circle. Owing to barriers of ice, heavy weather, or unfavourable winds, it might not be advisable to follow the Great Circle track between the two places which lie towards the polar regions; recourse is then made to—

Composite Great Circle Sailing, which is a course lying between the Great Circle and the rhumb line. The highest practical latitude is made the latitude of the vertex for the arc of two circles, one passing through the starting point and the other through the port of destination; the route would then be along the first arc to the vertex, next on the parallel of latitude to the vertex of the other arc, and finally along this arc to the port of destination.

Windward Great Circle Sailing.—If a ship encounters a head wind, which is blowing along the Great Circle, it does not matter which tack the vessel is placed on, taking into consideration probable shift of winds and currents. If the rhumb line deviate more than two points from the Great Circle, it is evident that by shaping the course on the rhumb line, and then laying the ship on the wrong tack, she will head more than eight points away from the direction of the port; while on the other tack she would lie within less than four points of the course. Thus a navigator acquainted with the principle of Great Circle Sailing can always take full advantage of every wind which blows. This is not the case with the mariner who is unacquainted with the science of Great Circle Sailing; in fact, he may frequently be heading away

from his port by following the course on a Mercator's chart, which is made on the supposition that the earth is a flat surface.

SAFETY COMES FIRST.

Study Notices to Mariners. Do not depend on sound which is variable. Buoys are liable to be out of position. Charts should be corrected up-to-date. Compass deviation should be carefully corrected at frequent intervals; allow for heeling error if any. Give all dangers a wide berth.

Allow for tides and currents which are variable, see "Tide Tables," and book of directions.

Keep your lights burning bright; give other vessels a wide berth, if there is danger of collision stop, and reverse your engines.

Fog.—Go at a moderate speed, and give one prolonged blast on your steam whistle. If you hear another vessel's whistle, syren, or fog horn, stop and navigate with caution until all danger of collision is over.

Lead.—Keep the lead going. Commence in good time and continue to take soundings until such time as the weather clears up.

Log.—Be careful your vessel does not overrun her position by account.

Look out.—The officer should keep a good look-out, and watch the steering, also attend to the night orders.

SUMMARY OF PENALTIES.

For misuse of pilot signals	£20
For misuse of distress signals all expenses incurred	
For not standing by the other vessel in case of collision—serious offence—certificate may be cancelled, etc.,	
For not reporting a derelict	5
For obstructing inspector of provisions	10
For failing to supply good provisions	100
For failing to have a certificated cook	25
Seamen are entitled to allotment	5
Boat drill and inspection as to life-saving appliances	10
For any false return as to passengers	20
For any false return as to cattleman	100
For carrying passengers on more than one deck below the water-line	500
For not keeping the log book in order	5
For making a false entry in the official log book	100
For not giving full particulars of collision in log book	20
For making entries in log book later than 24 hours after arrival	30
For colliding with lightship or buoys (also cost of damage)	50
For making false report to custom house	100
For submerging load-line	100
For not handing in grain certificate	100
For not taking precaution against grain cargo shifting	300
For not showing regulation lights £100, (or imprisonment)	
For breaking charter party, estimated amount of freight	
Seaman's effects proper entry must be made in log book	20
Emigrant ship food scale must be posted up in the 'tween decks under a penalty £2 per day	
For entering or leaving port without ensign	100
For flying unauthorised ensign	500

BRITISH STANDARDS OF WEIGHTS AND MEASURES.

Weight—Avoirdupois.

27·344 grains	=	1 drachm.
16 drachms	=	437½ grains = 1 oz.
16 ounces	=	7000 grains = 1 lb.
14 pounds	=	1 stone.
28 pounds	=	1 quarter.
4 quarters	=	112 lbs. = 1 cwt.
20 hundredweights	=	2240 lbs. = 1 ton.

Weight—Troy.

4 grains	=	1 carat.
6 carats, or 24 grains	=	1 pennyweight.
20 dwts.	=	480 grains = 1 troy ounce.
12 troy ozs.	=	5760 grains = 1 troy lb.
25 lbs.	=	1 quarter.
100 lbs.	=	1 cwt.
20 cwts.	=	1 ton of gold and silver.

Gold, silver, jewels, precious stones, and all liquids are weighed by this weight.

The standard for gold coin is 22 carats of fine gold, and 2 carats of copper melted together: for silver is 11 ozs. 2 dwts. of fine silver and 18 dwts. of alloy, which is now coined into 66s.

Length.

12 lines	=	1 inch.
7·92 inches	=	1 link.
12 inches	=	1 foot.
3 feet	=	1 yard.
6 feet	=	1 fathom.
5½ yards	=	1 rod, pole, or perch.

4 poles, or 100 links, or 66 feet = 1 chain.

40 perches, 10 chains, or 660 feet = 1 furlong.

1 cable's length = the tenth of a sea mile, or about 200 yds.

8 furlongs = 80 chains = 1760 yards = 5280 feet = 1 mile.
6080 feet = 1 knot or naut. mile (Admiralty).
3 miles = 1 league.
69½ miles = 1 degree (geographical).
360 degrees = circumference of globe.

Surface.

144 square inches	=	1 square foot.
9 square feet	=	1 square yard.
30¼ square yards	=	1 square pole, rod, or perch.
40 square poles	=	1 rood.
4 roods	=	4840 square yards = 1 acre.
640 acres	=	1 square mile.

Cubic or Solid Measure.

Cubic foot	=	1728 cubic inches.
Cubic yard	=	27 cubic feet, 21·033 bushels.
Stack of wood	=	108 cubic feet.
Shipping ton	=	40 cubic feet, merchandise.
Shipping ton	=	42 cubic feet of timber.

Liquid Measure.

The gill contains 8·665 cubic inches.
The pint contains 4 gills or 34·660 inches.
Quart = 2 pints = 8 gills.
Gallon = 4 quarts = 32 gills.

	Gals.	Qrs.	Pts.
Firkin or quarter barrel	9	36	72
Anker (10 gallons)	10	40	80
Kilderkin, rundlet, or ½ barrel	18	72	144
Barrel	36	144	288
Tierce (42 gallons)	42	168	336
Hogshead of ale (1½ barrel)	54	216	432
Puncheon	72	288	576
Butt of ale (3 barrels)	108	432	864

Wines are usually measured as follows:—

Pipe of Port	=	115 gallons.
,, Teneriffe	=	100 ,,
,, Marsala	=	93 ,,
,, Madeira and Cape	=	92 ,,
,, Sherry and Tent	=	108 ,,
Butt of Lisbon and Bucellas	=	117 ,,
Aum of Hock and Rhenish	=	30 ,,

Hogshead of Claret, 46; Port, 57; Sherry, 54; Madeira, 46 gallons.

Water for Ships.

Ton	210 gallons.	Barrel	36 gallons.
Butt	110 ,,	Kilderkin	18 ,,
Puncheon	72 ,,	10 lbs.	1 ,,

Angular Measure.

60 Seconds″	=	1 Minute.
60 Minutes′	=	1 Degree.
30 Degrees°	=	1 Sign.
90 Degrees	=	1 Quadrant.
180 Degrees	=	1 Semi-circle.
360 Degrees	=	1 Circumference.

Measures of Time.

60 Seconds	=	1 Minute.
60 Minutes	=	1 Hour.
24 Hours	=	1 Day.
23*h.* 56*m.* 4*s.*	=	1 Sidereal Day.
7 Days	=	1 Week.
28 Days or 4 weeks	=	1 Lunar Month.
28, 29, 30, or 31 Days	=	1 Calendar Month.
12 Calendar Months	=	1 Year.
365¼ Days	=	1 Common Year.
366 Days	=	1 Leap Year.

Apothecaries' Weight.

20 grains	=	1 scruple.	8 drachms.	=	1 oz.
3 scruples	=	1 drachm.	12 ozs.	=	1 lb.

Apothecaries' Fluid Measure.

60 minims ℥ (drops)	=	1 drachm.	f℥
8 drachms	=	1 ounce.	f℥
20 ounces	=	1 pint.	O
8 pints	=	1 gallon.	
4 drachms	=	1 tablespoonful.	
4 ounces	=	1 wine-glassful.	
3 ounces	=	1 tea-cupful.	

Dry Measure

2 pints	=	1 quart.	4 pecks	=	1 bushel.
4 quarts	=	1 gallon.	8 bushels	=	1 quarter.
2 gallons	=	1 peck.	5 quarters	=	1 load.

Timber Measure.

Petrograd Standard = 120 pieces $1\frac{1}{2}'' \times 11'' \times 12' = 165$ cubic feet.
Stack = 108 cubic feet. Cord = 128 cubic feet.
Load of unhewn timber = 40 cubic feet.
Load of squared timber = 50 cubic feet.
120 deals = a "hundred" deals.
Fathom of wood = 216 cubic feet.

USEFUL INFORMATION.

Nautical mile, generally called the Admiralty measured mile = 6080 feet.

The fathom = 6 feet.

A cable's length = the $\frac{1}{10}$ of a nautical mile.

A ship's cable = 15 fathoms, in all 120 fathoms.

A league = 3 miles.

A ton weight = 20 cwts.

A ton measurement = 40 cubic feet.

A ton measurement, bunkers, to make due allowance for bad stowage = 48 cubic feet.

A ton of fresh water = 210 gallons.

A ton of sea water = 35 cubic feet.

Ton's displacement of a vessel = 35 cubic feet.

A gallon of fresh water = 10 lbs.

A gallon of sea water = 10·2 lbs.

A cubic foot of water = 6·25 gallons.

A cubic foot of water weighs about 1000 ounces.

The Imperial gallon = 277·27 cubic inches.

To find the area of a circle the diameter being given :—

Multiply the square of the diameter by ·7854, the result = area.

To find the surface of a cylinder, the diameter and length being given :—

Multiply the diameter by 3·1416 to get circumference of the section, and again multiply this product by the length.

To find the volume of a cylinder, the diameter and length being given :—

Multiply the square of the diameter by ·7854, to get the area, and then multiply this area by the length.

To find the surface of a sphere :—

Multiply the diameter of the sphere by its circumference, and its product will be the surface.

To find the volume of a sphere :—

Multiply the cube of the diameter by ·5236, and the product will be the volume required.

Area of a triangle = $\frac{1}{2}$ base × the perpendicular.

Area of a square = square of one side.

Square inches ÷ ·7854 = circular inches.

Circular inches × ·7854 = square inches.

To Find the Capacity of a Cask.

RULE.

To calculate the capacity of a cask, multiply the half sum of the areas of the two interior circles, viz., at the head and the bung, by the interior length; the result is the contents in cubic inches, which, divided by 277·27 (the number of cubic inches in a gallon) will give the capacity in gallons.

RULE.

To find the area of a circle :—

Multiply the square of the diameter by ·7854, the result = area.

WORKED EXAMPLE.

A cask 34 inches long, bung diameter 24 inches, head diameter 20 inches. Find the capacity in gallons.

Bung diameter.	Head diameter.
24^2	20^2
× 24	× 20
96	400
48	× ·7854
576	1600
× ·7854	2000
2304	3200
2880	2800
4608	Area 314·1600
4032	
Area 452·3904	
Area 314·1600	
÷ 2) 766·5504	
$\frac{1}{2}$ Sum of Areas 383·2752	
× 34	
15331008	
11498256	
1 Gallon = 277.27 (Cubic Inches.)) 13031·3568 (46·99 Gallons.	
110908	
194055	
166362	
276936	
249543	
273938	
249543	
24395	

A cask as per above measurements will contain 47 gallons.

Areas of Triangles, Etc.

Given the length of base and altitude of triangle.

Area $= \frac{1}{2}$ (base $\times$ altitude).

Given the length of the three sides of a triangle.

Area $= \sqrt{s\,(s-a)\,(s-b)\,(s-c)}$ where $s=\frac{1}{2}\,(a+b+c)$.

Given two sides a and b and included angle C.

Area $= \frac{1}{2}\,a\,b$ sine C.

Area of a rectangle	=	length $\times$ breadth.
Area of a circle	=	$\pi\,r^2$ $\quad r$=radius.
Circumference of circle	=	$2\,\pi\,r$ $\quad$,,
Area of cylinder	=	$2\,\pi\,r^2+2\,\pi\,r\,l$ $\quad l$= length.
Volume of cylinder	=	$\pi\,r^2\,l$
Volume of pyramid or cone	=	$\frac{1}{3}$ perpendicular height $\times$ area of base.
Area of wedge	=	areas of top+bottom+end+both sides.
Volume of wedge	=	$\frac{1}{2}$ (length $\times$ breadth $\times$ height).
Area of sphere	=	$4\,\pi\,r^2$
Volume of sphere	=	$\frac{4\,\pi\,r^3}{3}$
Volume of cask	=	$\pi\,r^2\,l$, where r is the mean of the head and bilge radii, l being the length of cask.

Miscellaneous Questions involving Mensuration.

1. A staysail is 25 ft. long on the luff, and the diagonal from the clew to the luff is 10 ft. (drawn perpendicular to the luff). Neglecting round of foot and luff, required the number of square feet of canvas contained in the sail.

$$\frac{25\times10}{2} = 125 \text{ sq. feet.}$$

2. An iron tube 20 ft. long is 30 ins. (external diameter) and 26 ins. internal diameter. Find the volume of iron in the tube, and its weight. Specific gravity 8.

$\pi\,R^2\,l-\pi\,r^2\,l$

$=\pi\,(R^2-r^2)\,l$

$=\pi\,(R+r)\,(R-r)\,l$

$R=15$ in. $\pi=\frac{22}{7}$

$r=13$ $\quad R$ =external diameter

$R+r=28$ $\quad r$ =internal diameter.

$R-r=2$ $\quad l$ =length.

$$\frac{22}{\cancel{7}} \times \frac{\cancel{28}^{\,4}}{\cancel{12}_{\,3}} \times \frac{\cancel{2}}{\cancel{12}_{\,\cancel{6}\,3}} \times \frac{\cancel{10}^{\,5}}{\cancel{20}_{\,1}} = \frac{220}{9} = 24\tfrac{4}{9} \text{ cub. ft. volume of iron.}$$

35,840 ozs. to ton $\quad \frac{\cancel{11}}{\cancel{220}_{\,9}} \times \frac{\cancel{1000}^{\,125}}{\cancel{35840}_{\,\cancel{448}_{\,\cancel{56}_{\,28}}}} = \frac{1375}{252} = 5{\cdot}45$ tons

3. An oil tank measures 5 ft. 4 ins. in depth, 2 ft. 6 ins. in length, and 2 ft. in width. Required the number of gallons it will contain.

$5\frac{1}{3}$ ft. $\times$ $2\frac{1}{2}$ ft. $\times$ 2 ft. $= \frac{16}{3} \times \frac{5}{\cancel{2}} \times \frac{\cancel{2}}{1} = \frac{80}{3} = 26\frac{2}{3}$ cub. ft.

$6\frac{1}{4}$ gallons = 1 cub. ft. $\therefore \frac{\cancel{80}^{\,20}}{3} \times \frac{25}{\cancel{4}} = \frac{500}{3} = 166\frac{2}{3}$ gallons.

4. A cask 3 ft. 6 ins. in length, bilge diameter 28 ins., head diameter 20 ins., is filled with liquid. How many gallons does it contain?

Bilge dia. 28″ $\therefore$ radius = 14″
Head ,, 20″ $\therefore$,, = 10″
} mean radius = 12″=1′.

$$\frac{\overset{11}{\cancel{22}}}{\cancel{7}} \times \frac{\cancel{7}}{\cancel{2}} \times \frac{25}{4} = \frac{275}{4} = 68\tfrac{3}{4} \text{ gallons.}$$

5. A side bunker 22 ft. long, 12 ft. wide and 14 ft. deep contains coal. Required the number of tons allowing 44 cub. ft. per ton.

$$\cancel{22} \times \overset{6}{\cancel{12}} \times 14 \times \frac{1}{\cancel{44}\,\cancel{2}} = 84 \text{ tons.}$$

6. Required the number of cub. ft. space in a lifeboat 28 ft. long, $8\frac{1}{2}$ ft. broad, $3\frac{1}{2}$ ft. deep, coefficient ·6.

$$\frac{\overset{7}{\cancel{14}}}{\cancel{28}\,1} \times \frac{17}{\cancel{2}} \times \frac{7}{\cancel{2}} \times \frac{6}{10} = \frac{4998}{10} = 499{\cdot}8 \text{ or } 500 \text{ cub. ft.}$$

7. A hold has a cubic capacity of 35,000 ft. She loads 1600 cases, each 3 ft. by 2 ft. by 1·5 ft. Allowing 10 per cent. for broken stowage, what space is left in the hold?

$$\frac{16\cancel{00}}{1} \times \frac{3}{1} \times \frac{\cancel{2}}{1} \times \frac{3}{\cancel{2}} \times \frac{110}{\cancel{100}} = 15{,}840 \textit{ cf.}$$

	35,000
	15,840
Space left	19,160 *cf.*

8. A box-shaped vessel when empty has a draught of 1 ft. 6 ins. (mean). When loaded the draught is 8 ft. forward and 9 ft. aft. Supposing the tons per inch immersion (T.P.I.) to be 15, required the number of tons taken on board.

Mean light draught	1·5 ft.	
Mean loaded draught	8·5 ft.	8 ft. forward
Difference	7 ft.	9 ft. aft
	12	—
	84 inches	2)17
T.P.I.	15	—
	420	8·5
	84	
	1260 tons	

9. A hold containing 30,000 cub. ft. capacity has 300 tons of wheat taken in. What quantity of oats can be loaded on top of the wheat, allowing the stowage factor of the wheat to be 46 cub. ft. and that of the oats 80 cub. ft.?

300 tons wheat.	
46 cub. ft.	
13800	space occupied by wheat in cub. ft.
30000	cub. ft. capacity
8,0)1620,0	space left in cub. ft.
202·5	tons of oats.

10. A box-shaped vessel 300 ft. in length and 40 ft. in breadth floats at a mean draught of 15 ft. What is her displacement in sea water of average density?

$$\frac{300 \times 40 \times \overset{3}{\cancel{15}}}{\cancel{35}\,7}$$

Average density 35 cub. ft. per ton.

	300
	40
	12000
	3
7)36000	
	$5142\frac{6}{7}$ tons.

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